Agricultural Economics RESEARCH

CONTENTS FOR APRIL 1961 *Vol. XIII, No. 2*

UNITED STATES DEPARTMENT OF AGRICULTURE • Agricultural Marketing Service
Agricultural Research Service

Contributors

ANTHONY S. ROJKO is Head of the Price and Trade Research Section, Statistical and Historical Research Branch, AMS.

RAYMOND L. ANDERSON is an Agricultural Economist with the Land and Water Research Branch, Farm Economics Research Division, ARS, stationed at Fort Collins, Colorado.

LEWIS ATHERTON, Professor of History, University of Missouri, is a past president of the Agricultural History Society and author of *Main Street on the Middle Border*, as well as other books and numerous articles on the history of agriculture and rural business.

BEN H. PUBOLS, an Agricultural Economic Statistician in the Agricultural Economics Division, AMS, for many years has conducted research and prepared economic reports on citrus and other fruits and tree nuts. He regularly prepares *The Fruit Situation* and similar material for other USDA publications.

WAYNE D. RASMUSSEN has recently published an article and a review in *Technology and Culture*, the quarterly journal of the Society for the History of Technology. Dr. Rasmussen is Head of the Agricultural History Section, Statistical and Historical Research Branch, AMS.

JAMES R. DONALD is an Analytical Statistician with Cotton and other Fibers Section of the Agricultural Economics Division, AMS. His section is responsible for analysis of demand and supply for fibers, particularly cotton and wool.

L. D. HOWELL is an Economist in the Fibers Section of the Marketing Economic Research Division of AMS.

HARVEY SHAPIRO is an Economist in the Agricultural Finance Research Branch, Farm Economics Research Division, ARS, where he works on problems of farm taxation and rural government.

ARTHUR A. HARLOW is an Analytical Statistician in the Price and Trade Research Section, Agricultural Economics Division, AMS.

AGRICULTURAL ECONOMICS RESEARCH

A Journal of Economic and Statistical Research in the
United States Department of Agriculture and Cooperating Agencies

Volume XIII APRIL 1961 Number 2

Time Series Analysis in Measurement of Demand

By Anthony S. Rojko

Opinions differ among economists as to how effective statistical analyses using time series data can be in identifying factors affecting demand and in measuring their influences. Although this presentation may not materially modify these opinions, it should at least succeed in making even the most skeptical aware of some of the problems involved in analyses employing time series data. It is not the purpose of this paper to make a survey or review of previous demand studies. Instead, it concentrates on certain methodological approaches and what implications they may have in helping the analyst to measure demand. But with the many problems that face the statistical analyst in this task, perhaps good luck is what he needs most. Measurement of demand in the final analysis has no meaning unless it helps us answer some of the practical questions of economic life: Helping farmers to predict the expected price associated with given (or assumed) levels of production and consumer income, helping a Congressman to estimate the expected change in consumption if prices to farmers are raised when all other factors are left unchanged. This article is based upon a paper presented at the National Symposium on Dairy Market Development sponsored by the American Dairy Association in Chicago last November. Although the practical examples draw heavily on the dairy industry, the conclusions generally apply to all agricultural commodities. The author gratefully acknowledges helpful suggestions from Arthur Harlow and Hyman Weingarten.

THE BROAD PROBLEMS involved in making demand analyses, which are varied and many in number, are discussed under the following headings: (1) Some Necessary Ingredients in Demand Analysis; (2) Structural vs. Predictive Relations; (3) Simple vs. Complicated Methods; (4) Allowing for Changes in Structure; (5) Short- and Long-run Estimates of Demand; (6) Avoiding Nonsense Correlations Through Graphic Analysis and (7) How Many Variations Should We Try?

Some Necessary Ingredients in Demand Analysis

Assuming that an economic relation exists between the variables, what further conditions must be satisfied before reasonable statistical results can be obtained? Knowledge of these limitations is essential—they may influence the degree of refinement that is possible in demand analysis.

(1) As statistical analyses measure change, the first requirement is that variability in the data be sufficient to permit observation of the effect of change in one variable on other variables. For some commodities such as meat, the year-to-year variation in consumption may be substantial. Consumption of beef in the last decade varied from 56 to 85 pounds per person. The largest annual change was 15 pounds or about 25 percent. In only 2 years was the annual change less than 2 percent. In contrast, time series of dairy statistics frequently show little year-to-year change. Nonfarm per capita consumption of fluid milk and cream ranged between 329 and 333 pounds for the period 1948–54. Except for one year, all year-to-year changes were 1 to 2 pounds per capita. In the one exceptional year, consumption dropped 3 pounds, but even this dip was less than 1 percent. Per capita consumption of manufactured dairy products tends to vary more, but even here variation is not great. Per capita consumption

587091—61——1

of American cheese, for example, has ranged between 5.1 to 5.5 pounds since World War II, and the greatest change in any year was 0.4 of a pound, or about 8 percent.

To get statistical results with confidence, the data on which results are based should have greater variability than the error associated with the data. In some of our consumption data for short periods, the year-to-year changes in the data are probably less than the error associated with the data. It should not be surprising, therefore, that hoped-for results in estimating demand coefficients, using postwar data alone, have been difficult to obtain.

(2) A second condition for ideal application of price analysis to time series data is that no structural change shall have taken place during the period studied. If change has taken place, may it be allowed for by statistical means? As shown elsewhere in this paper, when structural changes do occur they may be serious enough to put severe limitations on the job of running an analysis based on any considerable period of time. Yet a certain minimum number of observations is necessary if any confidence is to be placed in the coefficients.

(3) Another statistical requirement is that the intercorrelation among the explanatory variables be at a minimum. If intercorrelation is high, it not only reduces the statistical significance of the demand coefficients but also affects the size of the coefficients. As shown by Fox and Cooney (*10*, p. 4),[1] the sign of the regression coefficient may change with high intercorrelation. Thus, we may have a regression analysis which explains a large percentage of the total variation in the dependent variable. Yet, because of high intercorrelation, the individual coefficients associated with the explanatory variables may be useless.

In demand analysis pertaining to dairy products, we encounter several areas in which this problem affects statistical measurement. It is difficult, for example, to measure the substitution effect between competing dairy products using time series analysis, simply because prices of these competing products are highly correlated over time. Prices of fluid skim milk cannot get out of line with prices of fluid whole milk, or with prices of evaporated milk, as the values of all are derived from the same raw material—milk. Other intercorrelation problems result from similar trends in two or more variables. Since World War II, the steady rise in consumption of broilers has been the result of a downtrend in prices reflecting production efficiencies and an uptrend in consumer incomes. We have no statistical means of isolating these joint trends.

(4) A fourth ingredient is that no serial correlation exists among the residuals. Serial correlation is present in most residuals computed from demand analyses. This effect can sometimes be minimized by using first differences (Foote *7*, pp. 30–32 and Cochrane and Orcutt *5*, pp. 54–55) or by adding the lagged dependent variable as an additional explanatory variable in the analysis (Nerlove and Addison *27*, pp. 877–879).

(5) A fifth requirement is concerned with the specification problem. Of the several specification errors, the one with which we are mainly concerned is the one that occurs when some of the conditions specified in the economic model are not fulfilled in our estimating procedure. Specifically, the method of estimation requires that certain conditions must be met in the model to get estimates with desirable properties. The model, in turn, specifies the form of the structural equation and the restrictions imposed upon the unknown parameters. As an example, least-squares regression analysis stipulates that the covariance, or the correlation between the residual and the explanatory variables, be zero (Wold and Faxer *38*). If results do not indicate this, the estimating method does not meet the specification of the problem. An incorrect economic theory is not a specification error—it is just wrong theory. Errors of observation in the data and the use of nonrepresentative series to reflect certain price or quantity changes also illustrate kinds of specification error. The problem of selecting representative series in any demand analysis can be perplexing—just plain rough. For example, we do not have a representative price for fluid whole milk that reflects fully some of the changes that have occurred in purchasing habits. The price series[2] of the last few

[1] Italic numbers in parentheses refer to Literature Cited, page. 52.

[2] MacPherson and Smith (*21*, pp. 5–6) state: "Average selling prices for milk packaged in types and sizes of coutainers used in households have declined over the 4-year period of April–June 1956 to April–June 1959 . . . . Listed selling prices for a selected group of fluid milk

years may have a slight upward bias since it does not fully reflect the shift to gallon purchases of milk at lower per unit (quart) costs.

Structural vs. Predictive Relations

Too frequently, people want a single and unique answer to a problem. They are not interested in *several* demand coefficients. They want a *single* demand elasticity which they can firmly fix in their minds for use in answering all their problems. But it is possible to obtain several different demand coefficients, depending upon the number of variables in a regression equation or upon the method of statistical fit. Users of results need to know that each coefficient may have a special use yet may suffer serious limitations in other uses. Take the case of the question: What changes may be expected in consumption of butter if incomes are to be raised by, say, 10 percent in the next year? Can we give a single answer? Should we give an income elasticity figure from a structural demand relation that is consistent with the Marshallian demand curve?[3] But will all other things remain constant—the *ceteris paribus* assumption under the Marshallian demand curve? Initially, at least theoretically, an increase in income results in a shift in the demand curve for butter by the amount specified by the income elasticity coefficient. But with a given supply and an increase in demand, the price of butter would rise. In effect, this would reduce the increase due to income and, at the same time, encourage greater supplies. But income also increases the demand for fluid milk and other dairy products. Results from statistical analyses indicate that if the total supply of milk cannot be increased to meet the increase in demand for total dairy products, consumption of butter will actually decrease even though the demand for it has increased. We have witnessed, of course, how the utilization pattern shifts in favor of fluid milk at the expense of butter when milk is in short supply. In short, the demand elasticity coefficient, based on *ceteris paribus* conditions, is useless unless we want to trace out the series of adjustments by an iterative process. A more useful coefficient is one that already takes into account all these intermediary adjustments. Thus, the kind of coefficient needed is what Buse (*3*) calls the total elasticity from the total demand response curve.

On the other hand, if prices of butter are at support levels and the Commodity Credit Corporation has stocks of butter, the increase in demand for butter, specified by the Marshallian demand elasticity, would be reflected in a like increase in consumption. In this case we get no simultaneous price effect from the supply side, at least no material effect, until CCC stocks are almost exhausted.

Can this dilemma be resolved? Perhaps not. Which answer should our time series analysis provide? We can minimize the confusion if we distinguish between structural and predictive relations. These two relations are not one and the same. The first is concerned with relations within the Marshallian concept of supply and demand curves. Predictive relations are those which are designed to give an estimate of the variable in question, such as price or consumption.[4]

Back in 1927, Elmer Working (*39*) recognized the difference between predictive relations and true structural demand relations.[5] In 1943, in a pioneer work, Haavelmo (*13*) showed statistically why the coefficients associated with the predictive relation were not the same as those in the structural relation, even though both relations in-

(Footnote 2 continued from page 38.)

distributors indicate that this decline has occurred in spite of the fact that prices for milk in individual types and sizes of containers have increased. The paradox of average prices declining while individual prices increase can be accounted for by two changes: First, and most important, a shift to larger containers at lower per quart prices; second, a shift away from higher priced varieties of milk . . . ."

[3] Structural relations are those that define the process by which a set of economic variables are believed to be generated.

[4] Statistically, the predictive relation can be looked upon as an estimator or general formula to which given or known observations can be applied to compute an estimate. In the field of statistics, we have a wide variety of estimators—unbiased estimators, consistent estimators, efficient estimators and sufficient estimators; minimum variance estimators, minimum x^2 estimators, minimum root mean square error estimators and maximum likelihood estimators; Baye's estimators, fiducial estimators, and least squares estimators; closest estimators and minimum confidence interval estimators, and, among others, believe it or not, "best" estimators.

[5] A similar line of reasoning is followed by Koopmans (*16*, pp. 27–35) and Foote (*6*).

volved the same variables. In fact, Haavelmo's article was the catalyst for the simultaneous equations work that followed its publication. It has inspired many econometricians to search for methods of quantifying the underlying basic structural relationships, such as the "true" demand and supply curves of economic theory—so much so that some analysts soon came to believe that least squares as a method of quantifying economic behavior was "old fashioned" and "outmoded." Others looked upon the simultaneous equations approach as a mystic manipulation, too difficult to comprehend. But of course neither idea was correct; each of these tools has a place in our kit.

The least squares approach is useful in showing what normal average relationships exist between sets of variables. Besides, it appears that some of the same factors that help or hinder reasonable least squares results also do so in the more refined methods, such as limited information method and two-stage least squares method. The important thing is to recognize that the simultaneous equations approach may be needed to determine statistically the coefficients in the structural relations. These, in turn, may be necessary to establish algebraically the predictive or estimating relations.[6] On the other hand, the least squares equation may be the most economical and efficient way of obtaining these predictive relations. This is the other aspect of the Haavelmo paper, the one that apparently has been ignored.[7] Foote and Waugh (*8*), Hildreth (*14*), Christ (*4*), and Klein (*15*) each review the merits of simultaneous and single equations. They stress that both methods of analysis are essential.[8] On the other hand, Wold (*37*) questions the presence of simultaneity in economic relationships and suggests that recursive relations fitted by least squares are more appropriate.

Closely associated with predictive relations are those formulations that can be used for evaluating policy programs. In many respects, such appraisals are only extensions of forecasting with changed structures. Difficulties arise when the hypotheses, assumptions, and objectives involved in quantifying economic relations differ statistically from those required for use of statistical results in program appraisal. In fitting economic relations, the important considerations are the nature and the availability of data and the adequacy of the statistical method employed.

These considerations often affect the kind of formulation fitted. But in using econometric results for program appraisal, answers are sometimes obtained only from special formulations which may not meet the more rigid requirements specified in fitting procedures such as availability of data. Also, we seldom have a unique statistical formulation using a single source of data in which all important coefficients are statistically significant. As a result, several formulations often are modified so that information from several sources may be pooled into a single formulation, which is then used for appraising programs. We need more information to determine whether the use of a system that incorporates results from several analyses gives better estimates than those obtained directly from fitted regressions. There is no question but that, for the period of fit, estimates from the fitted system probably are better. But since appraisal involves change in structure, there is also no question but that a known "poor" coefficient may cause considerable difficulty. Thus it is well to know how to integrate and use all the known information.

Simple vs. Complicated Models

Let us examine some of the available statistical methods for measuring demand relationships. These methods may be simple, but they *can* also be extremely complex; it may even make sense to classify estimating methods according to *degree*

[6] In econometric literature, these equations are usually referred to as "reduced form equations." Reduced form equations are equations that result when each endogenous variable in a system of equations is written as a linear function of all of the predetermined variables in the system. Depending on the circumstances, they may be (1) algebraically derived from the structural coefficients or (2) fitted by least squares.

[7] For example, see a forthcoming article by Waugh (*36*).

[8] Some emphasize the importance of obtaining "true" structural coefficients while others stress the importance of obtaining the "best" forecast. Contrary to prevailing notions, Liu (*20*) suggests that the complexity of modern economic society makes it much more likely that the true

(Footnote 8 continued.)
structural relationship is *under-* rather than *over-*identified. Since simultaneous equations methods cannot be used in *under*identified models, he suggests use of relationship including all important variables fitted by least squares.

of complexity. In this way, the kind of results that are obtained from each method can be compared with the amount of effort expended. Of course, other classifications are possible. The methods may be grouped into the single equation vs. the simultaneous equations approach. Much of the statistical measurement of demand from time series analysis falls into these two broad groups. Graphic analysis and least squares regression analysis fall in the single equation group. Listed in the approximate order of their complexity in the second group are: The reduced-form method, the two-stage least squares method, the limited information method, and the maximum likelihood full information method.

Some statistical methods lie somewhere between these two broad classifications and tend to be used less frequently. In this area are such methods as analysis of principal components, discriminant analysis, canonical correlations or regression between sets of variables, weighted regressions, distributed lags, indifference curve approach, and so on.[9] The purpose of this paper is not to discuss these methods in detail but rather to indicate broadly some of the aspects that should be considered before using any single method.

We are often under the illusion that we obtain poor results because we fail to include all the relevant information. It is true that the addition of another explanatory variable in a regression analysis may increase the coefficient of multiple determination (R^2). Since a system of equations brings to bear more information on the problem, is it safe to assume also that the results are also improved? Bigness in model construction does not necessarily mean better results.

Why do we need complex models? When several variables are jointly determined, several equations may be required to take into account this joint interrelationship. How many equations do we need? This depends upon the importance of some of these interrelationships. To account for the interrelationships among dairy products and their competing products with emphasis on competition between butter and margarine, Ladd (*18*, p. 646) developed a model containing 63 relations. This model has 13 demand equations in all. Of these only 6 are for dairy products, 6 are for competing products, and 1 is for the total demand for table fats. The other 50 equations include retail-supply, processor-supply and inventory-demand equations, production equations for 5 dairy products, equations for exports of evaporated milk and for imports of cheese, domestic shortening production equations, and margarine and shortening-ingredient price-index equations. No equations appear for the supply of milk on the farm which is presumed to be given in any year. Lifting this restriction would, of course, increase the number of equations.

Statistical methods of estimating sets of simultaneous equations are needed to estimate the "true theoretical relations," for example, the "true demand curve" for fluid milk or butter. Statistical results obtained from such systems of equations are valuable in helping us to understand the theory of interrelated markets for milk and dairy products at the different marketing levels. The Ladd study is an example of how such an integrated model helps one to understand better the interrelationships between the butter and margarine market, including the effect of certain institutional variables. The work that I have done using the simultaneous-equations approach also helps to explain why, under certain circumstances, simpler single-equation regressions do not give the kind of coefficients expected in Marshallian demand relations (*31*, p. 71). Estimation of the coefficients in the demand relation for butter is a good example.

Traditionally, butter had been considered as a buffer for sudden shifts in the supply position because of weather or other unexpected circumstances. Undoubtedly, this has reflected, in part, the general availability of equipment for making butter as opposed to that for making cheese and other manufactured products. Important also are the ease with which butter can be stored and its place in the dairy economy as an outlet for milk. As a result, to estimate consumption of butter, any analysis must take into account the supply of total milk and demand for other dairy products. As those who are familiar with the dairy industry know, consumption of fluid milk is affected little by immediate shifts in supply of total milk or the

[9] These methods are frequently overlooked in most books on econometrics. Each of these uses some form of regression analysis. Tintner (*32*) presents a good account of the first four methods and includes others not listed above. Nerlove (*26*) discusses the use of distributed lags in the measurement of demand for agricultural commodities. For an application of indifference curve approach to measurement of substitution in demand, see Waugh (*33*) and Meinken, Rojko, and King (*23*).

demand for competing dairy products. And, of course, low demand elasticity for fluid milk also tends in the very short run to insulate consumption of fluid milk from these factors. For this reason, as shown later in this paper, reasonable results may be obtained for the fluid sector using the single equation regression approach. Single equation regression analysis also suffices for butter and manufactured products when manufacturing milk prices are at support levels.

One of the primary advantages of formulating a complete model is that it provides a systematic way of taking into account all relevant information that may influence the estimate of one of the dependent (endogenous) variables. This can prove to be an important function, as it helps to suggest areas in which least squares regression analysis is sufficient. For example, results from a two-equation dairy model for milk at the farm level fitted by both the least squares and the limited information methods indicated that both methods gave approximately the same coefficients in the demand equation for total milk (*30*, p. 337). This indicated that a least squares fit was satisfactory for the demand equation. Frequently, by formulating a complete model and using our knowledge of the industry, we can select the relevant variables needed in an estimating equation that can be fitted by least squares. These equations may be used for estimating the dependent (endogenous) variables, and the total model need not be fitted by the limited information or other complex methods. In summary, the important question is, Does the statistical equation that is used to make the estimate reflect all the relevant information necessary to explain the economic behavior of the variable in question? There are several ways of incorporating this information in our estimating equation.

But enlarging the model to increase the amount of information that can be used in making estimates also brings certain disadvantages. One is related to the need for more rigid assumptions as the size of the model increases. How many analysts ever stop to question why most complex systems of equations are always fitted using linear relationships? Such models usually have additive identities. In a dairy model, the sum of the individual demands for fluid milk, cream, butter, cheese, powdered milk, and so on must equal the total demand for milk. Also, prices for dairy products at different marketing levels theoretically differ by the differences in the marketing services performed for each commodity, differences in the densities of each dairy product since prices are usually quoted on the basis of product weight, and differences in the quality of milk used in making the product. Demand and price relations must be in linear form to permit these identities. But demand relations might be multiplicative (curvilinear). If so, a regression based on data in logarithms would give a better fit. Sometimes it is possible to have semilogarithmic relationships, provided the additive variables involved can be expressed as actuals. I have seen several models in which the linear restriction had an important effect on the kind of results obtained (*9*, p. 35).[10] For similar reasons also, the same format is frequently followed for all equations in the model. That is, the data are either in actuals or in logs, or they are run as first differences of actuals or logarithms. Such uniformity is not essential in all instances. In fact, there is reason for some modifications.

Another difficulty in working with a large model is pinpointing its statistical weaknesses. In working with a single regression, several combinations of variables that appear to be consistent with theory are tried, and they are either accepted or rejected on the basis of statistical significance and intuitive judgment. It is easy to decide whether a particular variable will help or hinder results.

In working with a large model, the analyst too frequently evaluates its "goodness" by asking how many coefficients are significant, and too often he is happy when three-fourths of them meet the standard statistical test of significance. One reason for this is that, in the case of the limited information method, it is difficult to evaluate which explanatory variable is responsible for a "poor" coefficient, since all structural coefficients are jointly determined. In one of my models, I had expected the addition of the retail price of meats to affect the demand equation for cheese. But I

[10] Foote and Weingarten, in using Meinken's wheat model (*22*, pp. 36–50) to demonstrate the use of research results in analyzing alternative programs, found that it was necessary to substitute a curvilinear relationship for the feed demand for wheat in place of the fitted linear relationship. The fitted linear relationship was inadequate because, when the price of wheat approaches the price of corn, use of wheat for feed increases rapidly and by more than the quantity suggested by the linear relationship.

was surprised to find that it affected the coefficients in the demand equation for butter considerably more. It may be somewhat easier to trace out the effects in the two-stage least squares method. But if by trial and error we select only those explanatory variables that appear to give the "best" structural coefficients, we may be deluding ourselves into believing that we have the joint determination implicit in our original system of equations.

At this point, we might add that some of the difficulties in evaluating the results stem from the intercorrelation problem. In a single regression analysis, it is fairly easy to see the influence of intercorrelation on the coefficients obtained (*10*). When several equations are involved, however, we do not have a method for ascertaining the effect of high intercorrelation among the explanatory (predetermined) variables on the structural coefficient. Our experience is that these coefficients are affected and that high intercorrelation among the predetermined variables tends to contribute to larger standard errors in the structural coefficients. Some of our results, however, suggest that high intercorrelation among the predetermined variables apparently does not affect the predicting value of the estimating (reduced-form) equations, provided the economic variables stay close to their range of values included in the original analysis (*11*, p. 92). More work needs to be done in this area.

Whether the statistical model is simple or complex will depend also upon the methods used to measure substitution in demand. The three empirical measures of demand interrelationships are (1) direct and cross elasticities derived from statistical demand equations, (2) elasticity of substitution derived from price ratios and consumption ratios, and (3) partial indifference surfaces derived from demand coefficients and an assumed monotonic function of utility.[11]

In general, the research analyst will wish to obtain direct and cross price elasticities from the demand equation by the regression approach, as this method provides the greatest amount of information. Either single equation regressions or systems of equations may be used, depending upon the nature of the interrelationships between the competing products. If intercorrelation is high among the prices of substitutes, the demand function might specify these prices as price ratios. Quantities may also be expressed as ratios in the analysis. But empirical elasticities of substitution obtained by relating price ratios and consumption ratios tell us little about the "ease of substitution" or degree of competitiveness between the goods.

The complexity of the model is also affected by the way in which a static model is converted into a dynamic one. The simplest way to achieve such a conversion is to include the dependent (consumption) variable as a lagged explanatory variable in the regression. The lagged (consumption) variable in this formulation reflects past influences of prices, incomes and other factors, including customary levels of consumption. In this connection, additional discussion appears later in this paper.

Allowing for Changes in Structure

As stated earlier, time series analysis assumes that no changes in structure have occurred during the period of analysis; that if such structural changes have occurred, they can be allowed for statistically in the regression analysis. Changes that take place gradually over time and for which we have no specific explanatory variable are usually allowed for by the time variable. In this connection, some analysts may not fully realize that the addition of the time variable imposes certain restrictions on the kind of trend that results. It makes a difference, for example, whether the time variable is in actuals, in logarithms, or in some other form (*7*, pp. 39–43). Many regression analyses have been run using first differences of logarithms with a constant or "a" value obtained to measure the trend in the dependent variable over time. Most analysts may not be aware of the fact that this formulation only permits a trend that is increasing at an increasing rate. Intuitively, the formulation that permits the opposite may be desired. This deficiency may be corrected by taking first differences of logarithms in a demand relation which explicitly includes time as an explanatory variable.

If there has been a once-and-for-all change in structure (level of consumption), the use of a 0–1 variable may be satisfactory. To illustrate, the Special School Milk Act, passed in 1954, has resulted in a higher level of consumption of fluid

[11] For a study relating these three approaches—advantages and disadvantages of each—see Kenneth W. Meinken, Anthony S. Rojko, and Gordon A. King (*23*).

milk in a magnitude of about 7 pounds. How do we allow for this in a statistical analysis? If no substitution occurs between this milk and milk bought from commercial channels, an analysis can be run by subtracting out milk consumed under the special milk program. That is, consumption variables should represent only commercial takings. But we may not want to assume that no substitution has occurred. In this instance, the analysis should have an additional variable which designates the years through 1954 with a value of 0 and the years beginning with 1955 with a value of 1. A comparison of the results from two demand regressions for fluid whole milk for the period 1924–59 indicates how effectively the 0–1 variable can be used to reflect changes in structure. (Regressions for demand for fluid milk are given at the end of discussion, beginning with page 51.)

At this point, it may be well to add that preliminary graphic analysis can be useful in depicting changes in structure over time, as the section on graphic analysis in this paper attests.

Another way to handle changes in structure is to break the period into subperiods during which no change in structure occurred. This was done, for example, to determine the changing relationship between cheese and meat consumption over time. Analyses for the 1920's suggested that price of meat had no influence on consumption of cheese, while the analyses in the 1930's indicated the beginning of some influence. Postwar analyses, however, suggest that the price of meat is an important consideration influencing consumption of cheese. Also, although some margarine was consumed in the 1920's and 1930's, the price of margarine did not appear to influence the consumption of butter. But this is not true in the postwar period. In such instances, if the subperiods are sufficiently long, separate regressions can be run for each period and the results from each compared. But we cannot logically combine or run the analyses for the total period because the influence of the factor (price of margarine), which was relevant only during part of the period, is averaged for the whole period. This, of course, gives a meaningless coefficient. One possible way to use a single analysis for the total period would be to leave out the price of margarine and to use a 0–1 variable instead. Then the residuals from this analysis might be correlated with the price of margarine for those years in which the price of margarine could be expected to be an influence.

Short- and Long-Run Estimates of Demand

The literature abounds in confusion with regard to the definition of the length of run. Some of the confusion undoubtedly stems from the fact that the real world is a curious mixture of both short- and long-run adjustment. The difficulty occurs when we attempt to delineate how much of the current level of demand results from adjustments in the short-run or the long-run. What are some of the methods that analysts can use to measure these separate influences?

One method is to relate the period of observation used in the analysis to the length of run. In this instance, length of run depends on whether we use monthly, quarterly, annual, biennial, or longer periods of time as our time period for each observation in the time series analysis. This method assumes that the factors that affect consumption can be grouped according to length of time required for adjustment. Specifically, the quarterly analysis would measure the influence of certain factors while the annual analysis would measure only the influence of other factors. Such analyses can be rather informative. For one, quarterly analyses might depict differences in seasonal demand, such as the stronger demand for ice cream in summer than in winter. These differences presumably would cancel out when the analysis used annual data. One may analyze quarterly data in one of two ways. If the period of analysis is long enough, there are advantages to running each quarter separately, then comparing their results. One may also use the 0–1 variable concept in which all the quarters are included in the single analysis. In this instance, we add additional variables which take on the value of 0 or 1, depending on whether the period of observations includes the quarter.

The 0–1 variable is a useful tool when data are available for only a relatively short period. To illustrate, let us look at some quarterly regressions based on 13 observations using Market Research Corporation of America consumer panel data published by the Agricultural Marketing Service. The regressions based on data in logarithms for fluid whole milk are

$$X_1 = -1.065 + .27X_2 + .46X_3 + 48X_4$$
$$\qquad\qquad\qquad\quad (1.37) \quad (1.33) \quad (.45)$$

$$X_1 = 2.867 - 2.63X_2 - .20X_3 + .67X_4 - .045X_5$$
$$\quad\quad\quad (.64) \quad (.45) \quad (.16) \quad (.006)$$
$$- .038X_6 + .005X_7$$
$$\quad\quad (.005) \quad (.004)$$

in which X_1 is per capita purchases of fluid whole milk, X_2 the prices paid for fluid whole milk, X_3 the price of fluid skim milk, X_4 per capita disposable income, and X_5, X_6 and X_7 are for the second, third and fourth quarters, respectively, using the 0–1 concept. All economic values were deflated by the Consumer Price Index. The numbers in brackets are the standard errors of the regression coefficients. None of the coefficients in the first analysis are statistically significant. The coefficient of determination (R^2) was increased from .27 to .95 by allowing for seasonal differences. The price coefficient now has the correct sign although a demand elasticity of −2.63 is much too high. As expected, the analysis shows that consumption in spring and summer is lower than consumption in winter by about 10 percent. Consumption in fall is 1 percent higher, or about the same as in winter. These results should be used with caution because they are based on a relatively short period of time. The regressions are inserted to illustrate the effectiveness of the 0–1 variable.

In many instances, it is impossible to correlate the period of actual adjustment with some time period. This is true because adjustments are continuously taking place. Prices of agricultural products change more often than once a year. A statistical analysis that arbitrarily specifies periods, such as a year, measures only the average relationship between the variable involved. It is not surprising, therefore, that coefficients from an annual analysis including 10 years of observations differ from those based on longer periods such as 20 or 30 years. Factors that exhibit cyclical behavior are particularly affected.

Some analysts have defined short- and long-run coefficients in this context. They have run a regression for the total period and then separate regressions for subperiods. An analysis by decades might be run for the 1920's, the 1930's, and so on. A single analysis would also be run for the total period 1920–60. In each instance, the period of observation would be a year, yet the coefficients from the subregressions would reflect short-run factors, whereas the coefficients in the longer period analysis would tend to reflect long-run changes. Relative prices and the transient component of income could be expected to be of greater significance in the shorter analysis, while in the longer analysis, level of income would reflect longer-run changes.

Still another method to delineate between short- and long-run elasticities has been given increasing attention within the last decade. This method implies that we are continually making short-run adjustments which are superimposed upon some underlying long-run adjustment that the consumer seeks to attain. Implicit in the method is the fact that it takes several periods to make the adjustment following a given change in one factor while all other factors remain constant.

Two decades ago, Mighell and Allen (*24*) recognized the difference between instantaneous and normal adjustment to price changes. Elmer Working (*40*) made the first serious attempt to measure the difference between the short- and long-run elasticities of demand in this context. His approach consists essentially of using different moving averages of quantity and income to explain the level of current price. The length of run implied in the coefficient is directly related to the period covered by the average used. Some differences followed as to the interpretation that should be given to the demand coefficients obtained by Working (*2*, *17*, *29*, *12*). Ladd and Tedford (*19*) suggest a reasonable interpretation. They demonstrate that the Working method is a special case of a more generalized method. The method assumes that the current level of consumption is the result of past decisions on the part of consumers, as well as recent adjustment to the most recent change in price, income, or some other causal factor. Current price, price the year before, the price in the year before that, and on into the past, each had some influence on the present level of consumption. The more distant in the past, the less influence price exerts. If all past prices and incomes are included in the same analysis, the resulting high intercorrelation between prices and income over time poses serious statistical problems. For this reason, some analysts have used averages of past prices or incomes. Others have avoided this intercorrelation problem by using lagged consumption to reflect the influence of the past on current levels of consumption.

Nerlove (*25*, *26*, *27*) embarked upon a new approach to the estimation of short- and long-run elasticities of demand. He applied to the field of agriculture certain concepts of distributed lags which were known to econometricians but had somehow escaped the notice of agricultural economists. Nerlove's approach has several points in common with Working's method. Although Working did not specify a long-run function, as did Nerlove, such a function is implicit in the Working method. Nerlove's approach assumes that there is some long-run equilibrium quantity (consumption) which consumers attempt to achieve by continually making adjustments in the short-run in moving toward this long-run equilibrium. Since prices and incomes do not remain still long enough for complete adjustment to this equilibrium, we cannot observe the long-run equilibrium position statistically because it does not exist. As a result, the long-run demand function cannot be estimated directly. Nerlove gets around this difficulty neatly by defining an adjustment equation which, combined with the long-run demand function, gives an estimating equation in terms of observable variables. Equations (2) and (4) on pages 51 and 52 are examples of such estimating equations. Thus, from the information in the estimating equation which he fits by least squares and the adjustment equation, Nerlove computes algebraically the long-run demand elasticities. One of the variables in the estimating equations is lagged consumption. The Nerlove approach uses lagged consumption to reflect the influence of past prices and past incomes, while the Working method uses moving averages of past values. One of the real advantages of the Nerlove approach is that it reduces serial correlation in the residuals of the estimating equations.

As indicated by Brandow (*1*), the long-run elasticities so obtained can be affected by specification errors. Why can this be so? The relation between short- and the long-run elasticities is materially affected by the coefficient associated with the lagged consumption variable in the estimating equation. Implicit in the method is that the lagged consumption variable reflects *only* the past influence on current consumption of past prices, incomes, and other factors specified in the model. But past consumption also may reflect other factors. For example, Nerlove's short- and long-run elasticities may be obtained from some of the demand regressions for fluid milk on pages 51 and 52. Using equation (2), we can obtain a short-run price elasticity coefficient of −.32 and a long-run price elasticity of −.70. But if we use equation (4), the short-run price elasticity becomes −.37 while the corresponding long-run elasticity becomes −.56. These results indicate that specification errors can affect the estimates of long-run elasticities. For these same equations, the relationship between the short- and long-run elasticities for income would be the same as those shown for price.

As expected from economic theory, the long-run demand elasticities for fluid whole milk obtained by the Nerlove method are greater than elasticities obtained from regression analysis in the typical demand equation using annual data and longer periods of time, such as 20 or 30 years. In the latter, the corresponding price elasticities were −.62 and −.44 (from equations (1) and (2), respectively). The Nerlove long-run elasticities are those that give the total adjustment that would occur in consumption following a single change in price or income over a period of several years. These coefficients also assume that all other factors remain the same. But do all other factors remain the same? One should not confuse these long-run elasticities with those needed for making projections 10 or 20 years ahead. It may be that the average relationship obtained from a regression analysis based on a longer period of analysis, say 20 or 30 years, provides the more reasonable answer for use in these long-run projections. It may be that the real world is but a series of short-run adjustments and that the total adjustment implied by the long-run demand elasticities is never obtained. It may be that, in the long long-run, the elasticities for certain items, such as dairy products, are rather low. Some signs indicate just such a position.

Analysis of survey or cross-section data indicates that the income elasticities are lower for people in the high-income bracket than for those in the low-income bracket. One of the marks of a progressive economy is that in addition to the rise in the level of real income, income disparities become less pronounced. These two elements would tend toward the lowering of demand elasticities over time. This would definitely be true for milk at the farm level. However, the increase in the demand for marketing services, which apparently

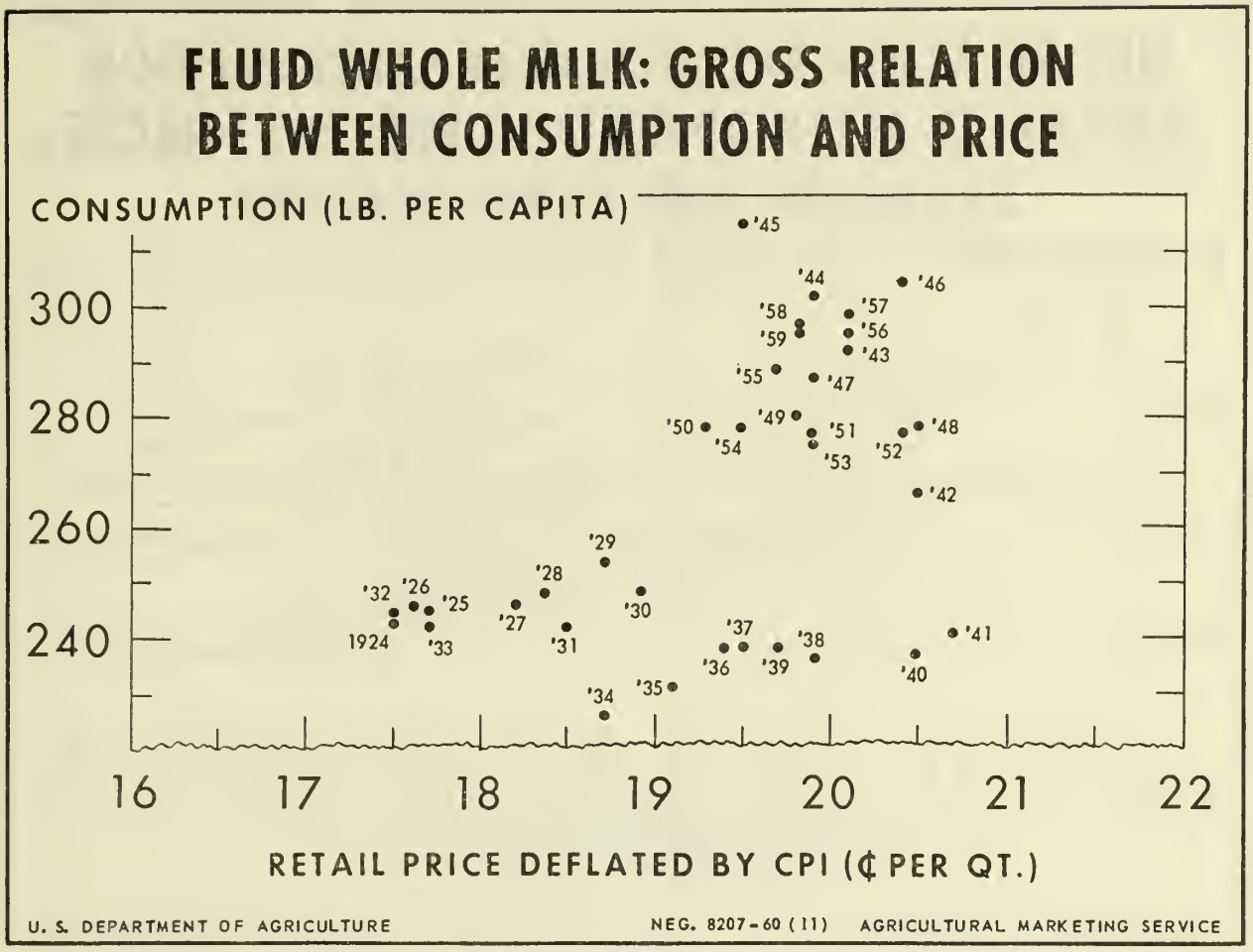

Figure 1.

is also associated with a rising economy, would tend to maintain the demand elasticities at the consumer level. But this area is beyond the scope of this paper, even though it poses some interesting avenues to adventure.

Whatever interpretation of the long-run demand elasticities obtained by the Nerlove method may be made, it is desirable to stress the fact that the estimating equation developed in his method is useful in forecasting consumption a year or two in advance.

The concept of distributed lags has recently been applied to time series data in measuring the effect of expenditures for advertising and promotion on the demand for farm products. Nerlove and Waugh (*28*, *35*) used this concept in the analysis of returns to orange growers from producer-financed advertising during the last 50 years. In their study, a method was developed to measure the long-run rate of return on advertising expenditures that could then be equated to returns from other forms of investment.

Avoiding Nonsense Correlations Through Graphic Analysis

Some agricultural economists and statisticians have become so intrigued with new mathematical methods and computing techniques that they have neglected a powerful simple tool—graphic analysis.[12] The greatest value of graphics in research is in making a quick preliminary analysis to determine the relevant variables and the form of the relationships among these variables. In addition, graphic analysis can be of material value in pinpointing changes in structure over time. Further-

[12] For the many uses of graphic analysis in agricultural economics, see Waugh (*34*).

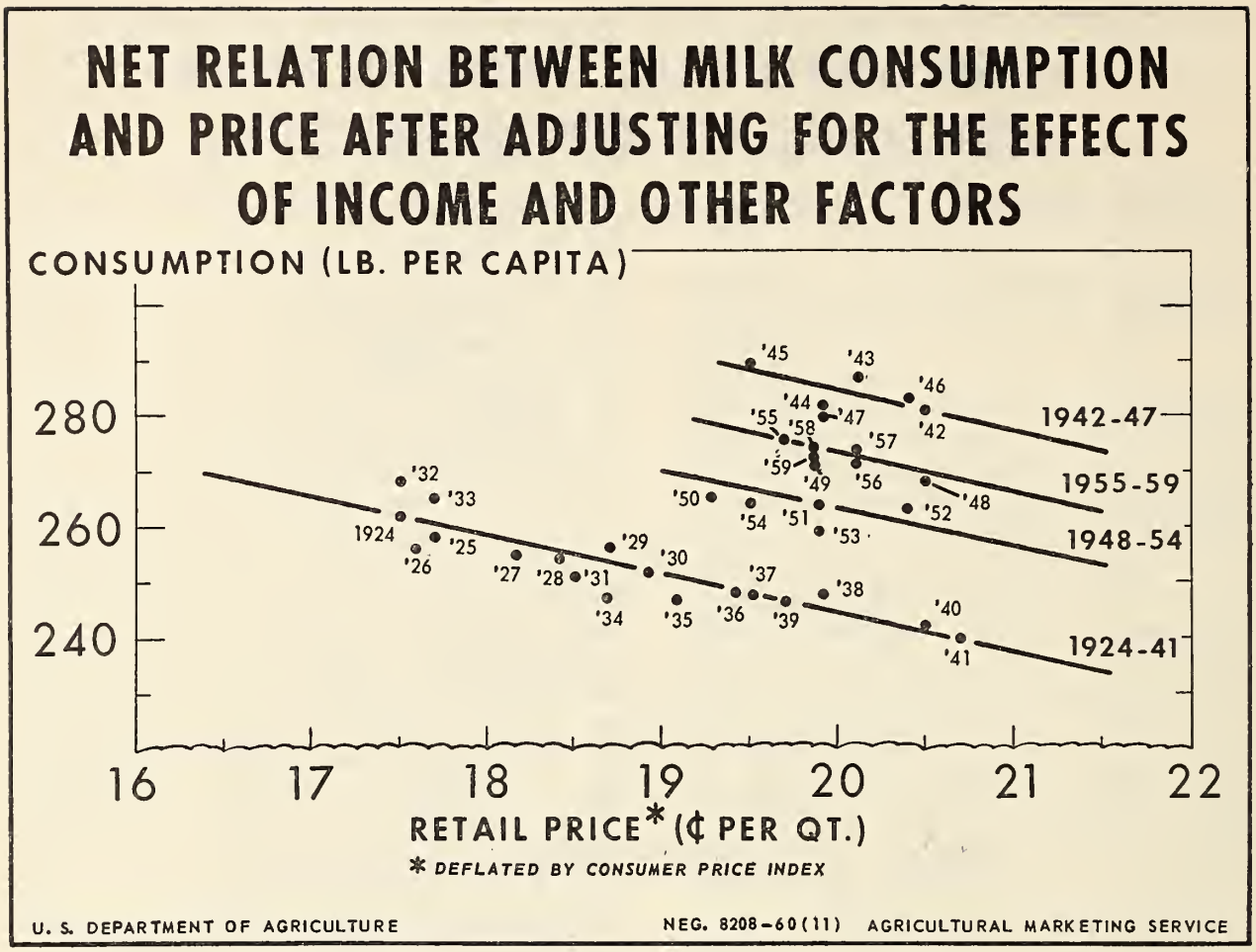

Figure 2.

more, carrying out a graphic analysis provides the analyst with insight about the data which he might otherwise miss.

Figures 1 to 5 indicate how graphic analysis can be used to provide insight as to the kind of regressions that should be run. Figure 2 indicates differences in levels of demand in the period between World War I and World War II, the period of World War II, and the two postwar periods. Demand analyses usually exclude the period of World War II. But by allowing for a shift in level, and by using discretionary income as an additional variable, the war years can be made part of the total analysis. Because of shortages in durable goods, consumers' cash position as reflected by discretionary income was strong; this position tended to increase expenditures for those items (fluid milk) that were available. The graph in figure 2 also appears to suggest that in 1948 and 1949, we were still adjusting from the high wartime levels even though actual consumption during these years was essentially at 1950–54 levels. Demand appeared to be relatively stable during 1950–54. The higher level for 1955–59, of course, was due to the introduction of the special milk program in 1954. The graphic analysis in this section provided the basis for equation (3). (See page 51.)

How Many Variations Should We Try?

Agricultural economists and statisticians frequently like to try several variations in conducting regression analyses. These variations can be

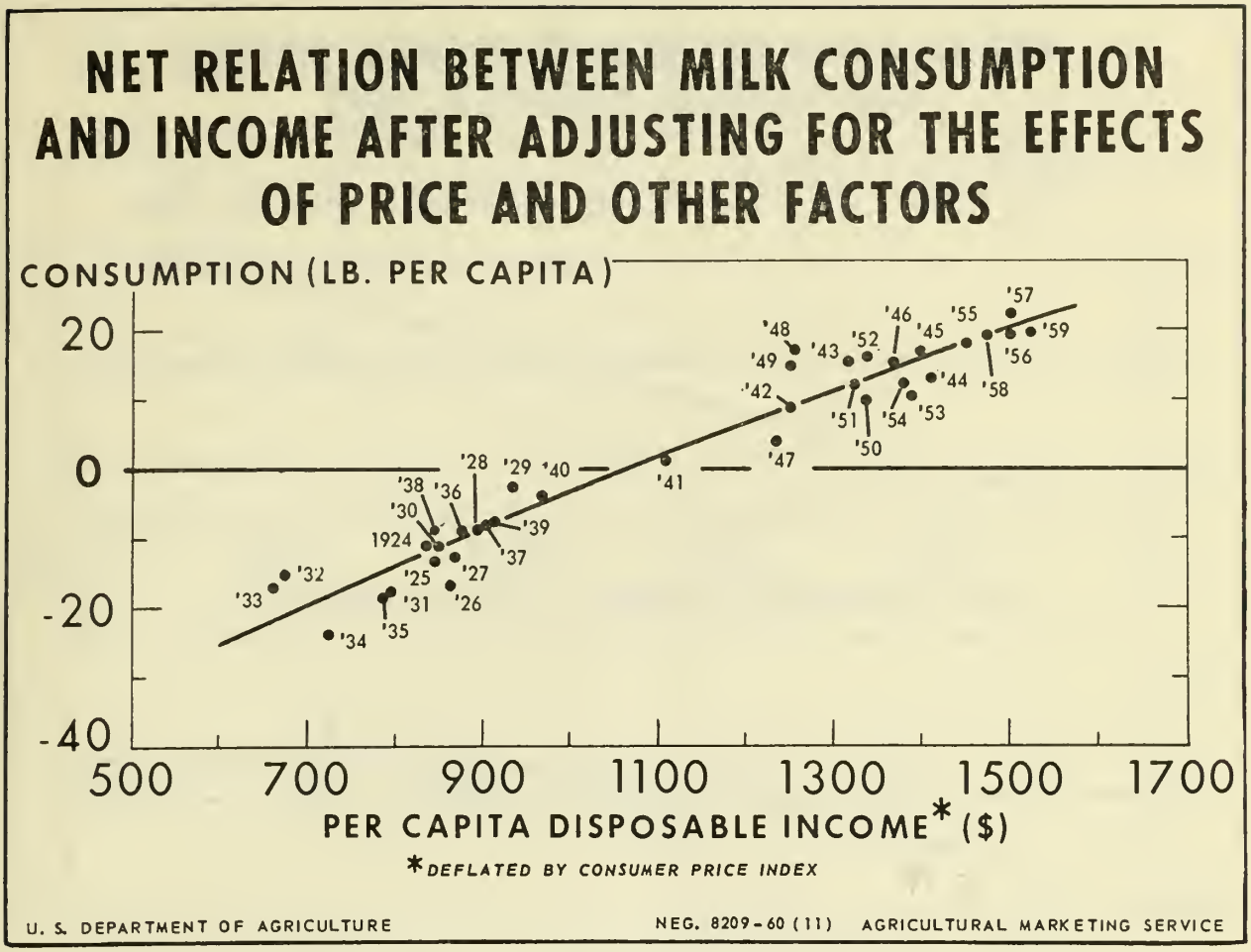

Figure 3.

grouped into three broad categories. The first concerns itself with basic changes in structure as indicated by the graphic analysis in the previous section of this paper. The second deals with the form of relationship—linear, curvilinear, and so on. The third is concerned with refinement of the data including use of series that may have a different conceptual base.

Let us examine the effect that each type of variation has on the expected results from regression analysis. There is no question but that the analyst will improve his results if he allows properly for basic changes in structure. The comparison of the first four demand regressions attests to this fact. (See pages 51 and 52.) This is further verified by the quarterly analyses for fluid whole milk. (See page 44.)

Use of the proper form of relationship can also be important. But unless there is a substantial difference, results will tend to be similar for several variations of this type. Review of past analyses of demand for fluid milk and dairy products suggests that the form of relationship is not too important in most instances.

Should we try variations that are really refinements in data, or different variations of the same basic set of data? The purpose of showing the many demand regressions on pages 51 and 52 is to illustrate the point that refinements in the third group may have little effect on the interpretation of the analysis. For this reason, if one obtains poor results in the first analysis, one should not expect improvements from refinements of this kind.

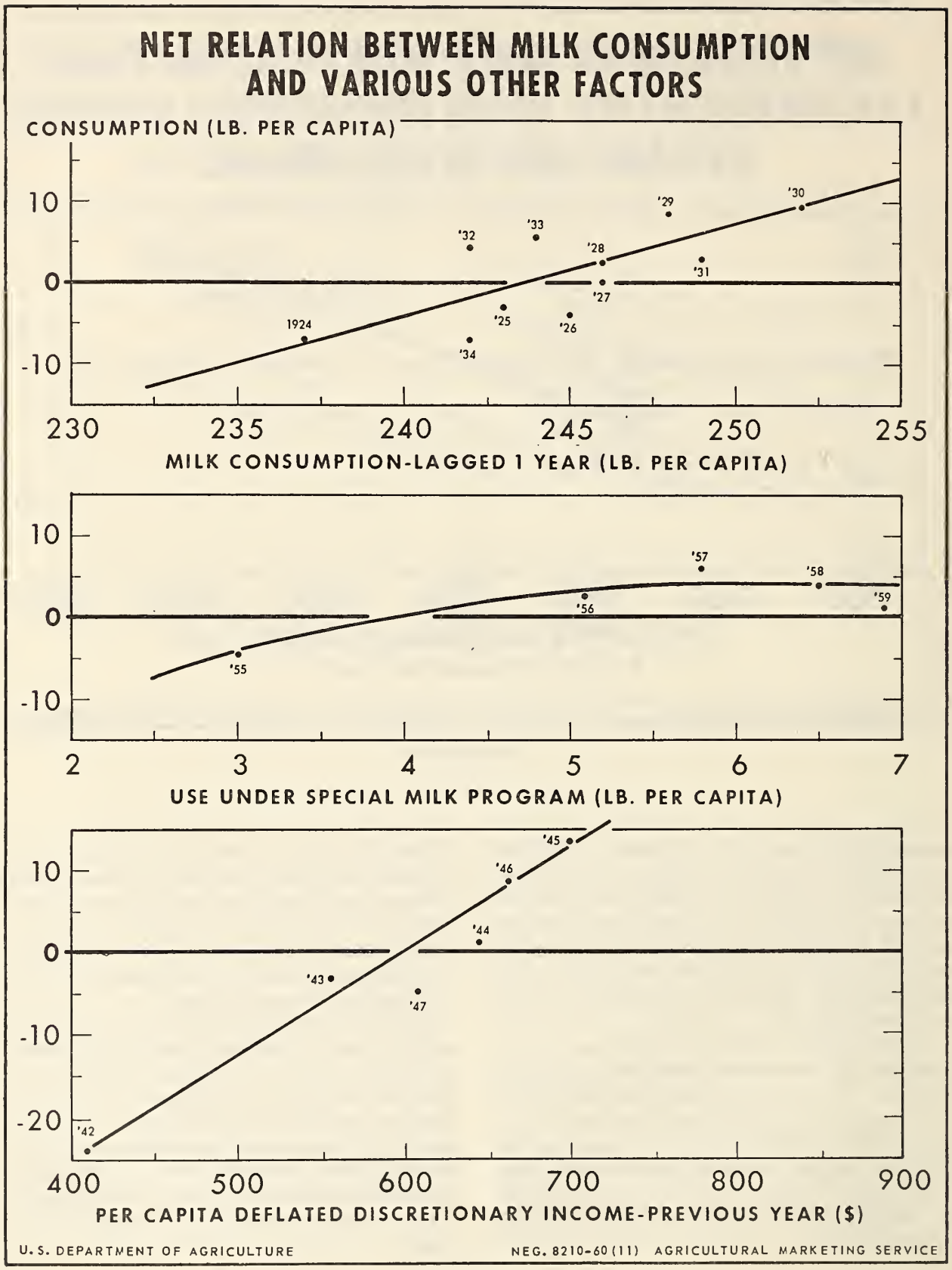
NET RELATION BETWEEN MILK CONSUMPTION AND VARIOUS OTHER FACTORS
CONSUMPTION (LB. PER CAPITA)
10
0
-10
230
235
240
245
250
255
'29
'30
'32
'33
'28
'31
'27
'25
'26
1924
'34
MILK CONSUMPTION-LAGGED 1 YEAR (LB. PER CAPITA)
10
0
-10
2
3
4
5
6
7
'57
'58
'59
'56
'55
USE UNDER SPECIAL MILK PROGRAM (LB. PER CAPITA)
10
0
-10
-20
400
500
600
700
800
900
'45
'46
'44
'43
'47
'42
PER CAPITA DEFLATED DISCRETIONARY INCOME-PREVIOUS YEAR ($)
U.S. DEPARTMENT OF AGRICULTURE
NEG. 8210-60(11) AGRICULTURAL MARKETING SERVICE

Figure 4.

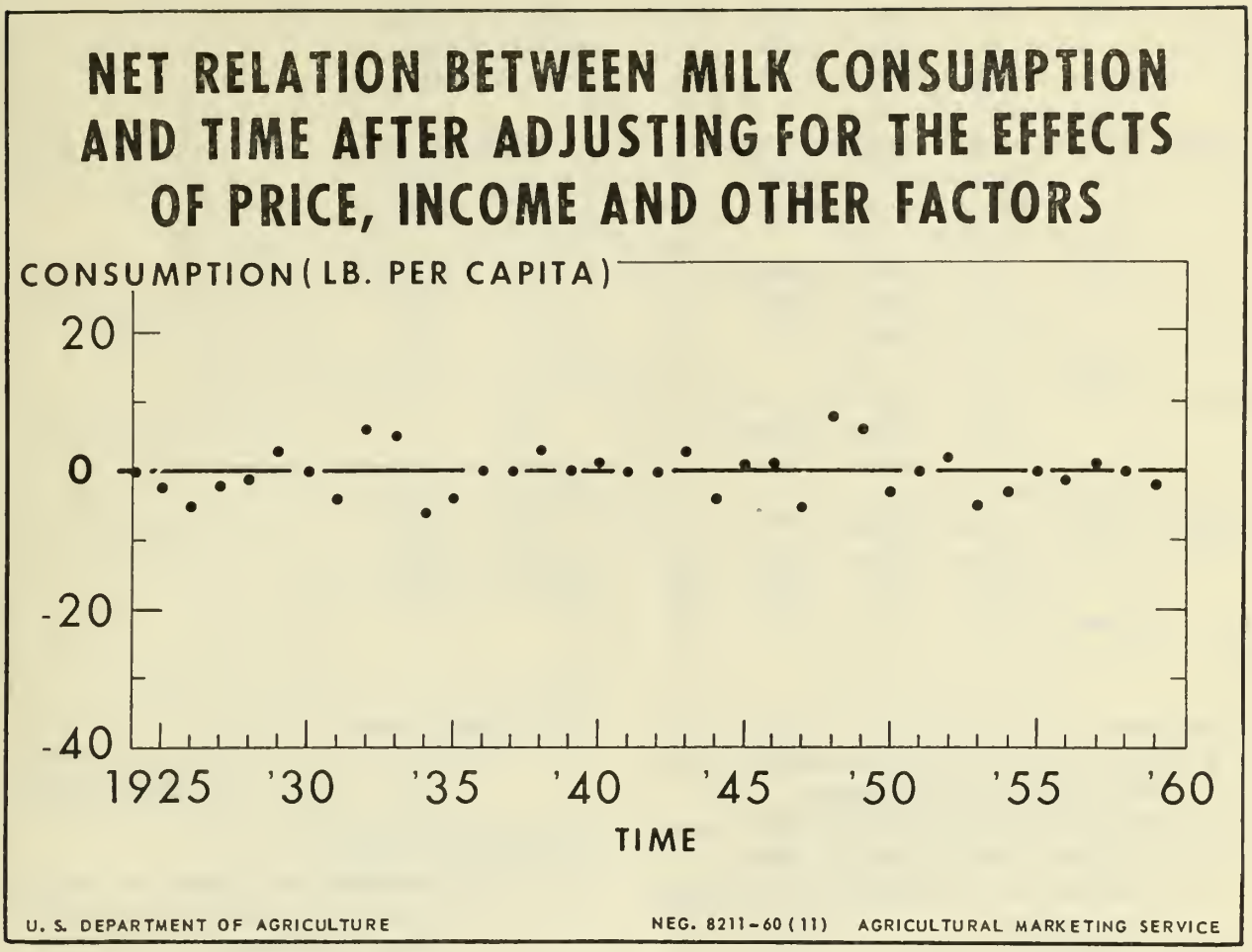

Figure 5.

Regressions for Demand for Fluid Milk [13]

Based on data in logarithms for 1924–59:

(1) $X_1' = 3.2022 - \underset{(.17)\ (.27)}{.62X_2} + \underset{(.03)\ (.83)}{.41X_3}$

$R^2_{1.23} = .87 \qquad s_{1.23} = .02$

(2) $X_1' = 1.5087 - \underset{(.12)\ (.17)}{.32X_2} + \underset{(.04)\ (.50)}{.21X_3} + \underset{(.08)\ (.59)}{.54X_4}$

$R^2_{1.234} = .95 \qquad s_{1.234} = .01$

(3) $X_1' = 2.9658 - \underset{(.12)\ (.33)}{.44X_2} + \underset{(.04)\ (.50)}{.23X_3} + \underset{(.008)\ (.62)}{.058X_5} + \underset{(.008)\ (.27)}{.026X_6} + \underset{(.010)\ (.35)}{.040X_7}$

$R^2_{1.23567} = .96 \qquad s_{1.23567} = .009$

[13] The variables are identified at the end of the formulas. Numbers in upper parentheses are standard errors of the regression coefficients; lower parentheses contain partial coefficients of determination.

(4) $X_1' = 2.0731 - .37X_2 + .22X_3 + 34X_4 + .029X_5 + .005X_6 + .013X_7$

(.10) (.04) (.10) (.012) (.009) (.012)

(.31) (.55) (.26) (.17) (.009) (.04)

$R^2_{1.234567} = .97$ $s_{1.234567} = .008$

(5) $X_1' = 3.2010 - .64X_2 + .26X_3 + .051X_5 + .017X_6 + .029X_7 + .014X_8$

(.19) (.05) (.010) (.010) (.013) (.011)

(.27) (.50) (.48) (.09) (.14) (.05)

$R^2_{1.235678} = .96$ $s_{1.235678} = .009$

(6) $X_1' = 2.9039 - .39X_2 + .10X_3 + .046X_5 + .015X_6 + .028X_7 + .18X_9$

(.11) (.06) (.009) (.008) (.010) (.07)

(.32) (.08) (.49) (.11) (.21) (.21)

$R^2_{1.235679} = .97$ $s_{1.235679} = .009$

(7) $X_1' = 2.5814 + .14X_3 + .063X_5 + .026X_6 + .048X_7 - .14X_{10}$

(.04) (.009) (.010) (.011) (.07)

(.30) (.59) (.19) (.38) (.11)

$R^2_{1.356710} = .94$ $s_{1.356710} = .011$

(8) $X_1' = 1.6156 + .14X_3 + .37X_4 + .030X_5 + .005X_6 + .018X_7 - .083X_{10}$

(.03) (.13) (.014) (.011) (.014) (.067)

(.36) (.23) (.14) (.007) (.05) (.05)

$R^2_{1.3456710} = .96$ $s_{1.3456710} = .010$

Description of Variables:

X_1—Fluid whole milk, civilian nonfarm consumption, pounds per person.

X_2—Retail price for fluid milk (AMS series) deflated by CPI, cents per quart.

X_3—Disposable income deflated by CPI, dollars per person.

X_4—X_1 lagged one year.

X_5—Value of 1 for all years except 1943–47 when the value of 10 is used.

X_6—Value of 1 for all years except 1948–54 when value of 10 is used.

X_7—Value of 1 for all years except 1955–59 when value of 10 is used.

X_8—Time trend, 1924=1.

X_9—X_3 lagged one year.

X_{10}—Retail price for fluid milk (AMS series) deflated by CPI, food, cents per quart.

Literature Cited

(1) Brandow, G. E.
1958. A note on the Nerlove estimate of supply elasticity. Jour. Farm Econ. 40:719–722.

(2) Breimyer, Harold F.
1955. Elmer Working: The demand for meat. Agr. Econ. Research. 7:73–77.

(3) Buse, Rueben C.
1958. Total elasticities—a predictive device. Jour. Farm Econ. 40:881–891.

(4) Christ, Carl F.
1960. Simultaneous equation estimation: any verdict yet? Econometrica. 28:835–845.

(5) Cochrane, D., and Orcutt, G. H.
1949. Application of least squares regression to relationships containing autocorrelated error terms. Jour. Amer. Statis. Asso. 44:32–61, illus.

(6) Foote, Richard J.
1955. A comparison of single and simultaneous equation techniques. Jour. Farm Econ. 37:975–990.

(7) ———
1958. Analytical tools for studying demand and price structures U.S. Dept. Agr. Agr. Handb. 146.

(8) ——— and Waugh, Frederick V.
1957. Results of an experiment to test the forecasting merits of least squares and limited information equations. U.S. Agr. Marketing Serv.

(9) ——— and Weingarten, Hyman

1956. HOW RESEARCH RESULTS CAN BE USED TO ANALYZE ALTERNATIVE GOVERNMENTAL POLICIES. Agr. Econ. Research. 8:33–43.

(*10*) FOX, KARL A., AND COONEY, JAMES F.
1954. EFFECTS OF INTERCORRELATION UPON MULTIPLE CORRELATION AND REGRESSION MEASURES. U.S. Agr. Marketing Serv. AMS–341.

(*11*) GERRA, MARTIN J.
1959. THE DEMAND, SUPPLY, AND PRICE STRUCTURE FOR EGGS. U.S. Dept. Agr. Tech. Bull. 1204.

(*12*) GISLASON, CONRAD
1957. A NOTE ON LONG-RUN PRICE ELASTICITY. Jour. Farm Econ. 39:798–802.

(*13*) HAAVELMO, TRYGVE
1943. THE STATISTICAL IMPLICATIONS OF A SET OF SIMULTANEOUS EQUATIONS. Econometrica. 11:1–12.

(*14*) HILDRETH, CLIFFORD
1960. SIMULTANEOUS EQUATIONS: ANY VERDICT YET? Econometrica. 28:846–854.

(*15*) KLEIN, L. R.
1960. SINGLE EQUATION VS. EQUATION SYSTEM METHODS OF ESTIMATION IN ECONOMETRICS. Econometrica. 28:866–871.

(*16*) KOOPMANS, TJALLING C.
1953. IDENTIFICATION PROBLEMS IN ECONOMIC MODEL CONSTRUCTION. In Studies in Econometric Method. Cowles Commission for Research in Economics Monogr. 14.

(*17*) KUZNETS, G. M.
1953. MEASUREMENT OF MARKET DEMAND WITH PARTICULAR REFERENCE TO CONSUMER DEMAND FOR FOOD. Jour. Farm Econ. 35:878–895.

(*18*) LADD, G. W.
1960. A STATISTICAL ANALYSIS OF CERTAIN INSTITUTIONAL VARIABLES IN THE BUTTER AND MARGARINE MARKET. Iowa Agr. Expt. Sta. Research Bull. 474.

(*19*) LADD, GEORGE W., AND TEDFORD, JOHN R.
1959. A GENERALIZATION OF THE WORKING METHOD FOR ESTIMATING LONG-RUN ELASTICITIES. Jour. Farm Econ. 41:221–233.

(*20*) LIU, TA-CHUNG
1960. UNDERIDENTIFICATION, STRUCTURAL ESTIMATION, AND FORECASTING. Econometrica. 28:855–865.

(*21*) MACPHERSON, D. D., AND SMITH, HELEN V.
1959. MILK DISTRIBUTORS' SALES AND COSTS, JULY-SEPTEMBER 1959. U.S. Dept. Agr. MDSC–12.

(*22*) MEINKEN, KENNETH W.
1955. THE DEMAND AND PRICE STRUCTURE FOR WHEAT. U.S. Dept. Agr. Tech. Bull. 1136.

(*23*) ———, ROJKO, ANTHONY S., AND KING, GORDON A.
1956. MEASUREMENT OF SUBSTITUTION IN DEMAND FROM TIME SERIES DATA—A SYNTHESIS OF THREE APPROACHES. Jour. Farm Econ. 38: 711–735.

(*24*) MIGHELL, R. L., AND ALLEN, R. H.
1939. DEMAND SCHEDULES—"NORMAL" AND "INSTANTANEOUS" Jour. Farm Econ. 21: 555–569.

(*25*) NERLOVE, MARC
1958. DISTRIBUTED LAGS AND THE ESTIMATION OF LONG-RUN SUPPLY AND DEMAND ELASTICITIES: THEORETICAL CONSIDERATIONS. Jour. Farm Econ. 40: 301–311.

(*26*) ———
1958. DISTRIBUTED LAGS AND DEMAND ANALYSIS FOR AGRICULTURAL COMMODITIES. U.S. Dept. Agr. Agr. Handb. 141.

(*27*) ——— AND ADDISON, WILLIAM
1958. STATISTICAL ESTIMATION OF LONG-RUN ELASTICITIES OF SUPPLY AND DEMAND. Jour. Farm Econ. 40: 861–880.

(*28*) ——— AND WAUGH, FREDERICK V.
ADVERTISING WITHOUT SUPPLY CONTROL: SOME IMPLICATIONS OF A STUDY OF THE ADVERTISING OF ORANGES. Submitted to Jour. Farm Econ.

(*29*) O'REGAN, WILLIAM G.
1955. DEMAND FOR MEAT. Jour. Farm Econ. 37: 752–755.

(*30*) ROJKO, ANTHONY S.
1957. ECONOMETRIC MODELS FOR THE DAIRY INDUSTRY. Jour. Farm Econ. 39: 323–338.

(*31*) ———
1957. THE DEMAND AND PRICE STRUCTURE

FOR DAIRY PRODUCTS. U.S. Dept. Agr. Tech. Bull. 1168.

(*32*) TINTNER, GERHARD
1952. ECONOMETRICS. New York. 370 pp.

(*33*) WAUGH, FREDERICK V.
1956. A PARTIAL INDIFFERENCE SURFACE FOR BEEF AND PORK. Jour. Farm Econ. 38: 102–112.

(*34*) ———
1957. GRAPHIC ANALYSIS IN AGRICULTURAL ECONOMICS. U.S. Dept. Agr. Agr. Handb. 128.

(*35*) ———
1959. NEEDED RESEARCH ON THE EFFECTIVENESS OF FARM PRODUCTS PROMOTIONS. Jour. Farm Econ. 41: 364–376.

(*36*) ———
THE PLACE OF LEAST SQUARES IN ECONOMETRICS. To be published in Econometrica, July 1961.

(*37*) WOLD, HERMAN O. A.
1959. ENDS AND MEANS IN ECONOMETRIC MODEL BUILDING. In Grenander, Ulf, ed., Probability and Statistics: The Harald Cramér Volume, 434 pp., illus. New York.

(*38*) WOLD, H., AND FAXER, P.
1957. ON THE SPECIFICATION ERROR IN REGRESSION ANALYSIS. Annals Math. Statis. 28: 265–267.

(*39*) WORKING, ELMER
1927. WHAT DO STATISTICAL "DEMAND CURVES" SHOW? Quart. Jour. Econ. 4: 212–235, illus.

(*40*) WORKING, ELMER J.
1954. DEMAND FOR MEAT. Chicago: Institute of Meat Packing.

The Irrigation Water Rental Market: A Case Study

By Raymond L. Anderson

Research on the market for irrigation water has been initiated to examine the institutional arrangements that have developed in certain areas to make irrigation water more readily transferable between farmers who have varying seasonal needs for water. This article outlines the manner and extent that farmers and irrigation companies in the South Platte Basin have developed arrangements for transferring water during a single crop season.

INTENSIVE AGRICULTURE in the semiarid West depends upon an adequate water supply. Even in areas where water is generally considered adequate, problems arise as to allocation of water among farms in most crop seasons.

During the last 60 years, the irrigation companies in the South Platte Basin have developed a rental procedure for transferring irrigation water from one user to another. The rental market evolved because of varying needs for available water and varying ownership of irrigation company stock.

The many reasons why water users may have insufficient or excess water include changes in crop patterns, development of irrigation wells, acquisition of additional water stock for insurance against short-water years, water stock split off when land was sold, development of additional land for irrigation, and need for more water stock than was originally anticipated.

Irrigation in the South Platte Basin was developed by privately owned irrigation companies. These companies are organized mainly as mutual companies in which the water users own the stock. Though the area has about 100 irrigation firms, 10 or 12 major companies cover a substantial part of the irrigated land.

Under strict appropriation doctrine, water is attached to the land by prior development of irrigation works. Whenever the appropriator fails to use the water or allows others to use it the right can be lost to another. Beneficial use is a requirement for retaining an appropriative right, but the question of what constitutes beneficial use is difficult to determine with any degree of precision, as any level of beneficial use is permissible. Modification of the appropriation doctrine through the evolution of a rental system under which water can be transferred to those who can make higher economic use of it allows a much more efficient use

of limited water supplies. In this paper, "water rental" means seasonal transfer of water between water users.

Water rental is possible in this region because of (1) company ownership of water rights; (2) development of privately owned storage reservoirs; and (3) availability of supplementary water supplies from the Colorado-Big Thompson Project.

The importance of company ownership of the water right lies in the fact that water rights are not attached to any specific tract of land, as is common under the appropriation doctrine. Under the company-ownership arrangement, the water users own stock in the ditch company. They receive water dividends according to the amount of stock owned without regard to the amount of land under the ditch. These stocks are treated as personal property that can be bought, sold, or rented at will.

The development of privately owned reservoirs is the second factor that makes rental of water possible. Farmers own stock in these reservoirs and receive water according to stock held. This water can be delivered on a demand basis; it is particularly valuable for late-season irrigation.

The third factor permitting the rental of water is the Colorado-Big Thompson Trans-Mountain Diversion Project. Water delivered by the project is administered by the Northern Colorado Water Conservancy District and is freely tranferable among water users anywhere in the conservancy district. The area in which effective water transfers can be made is bounded by Boulder on the south, Fort Collins on the north, and Fort Morgan on the east—a triangular area 70 miles wide at its western base and tapering to the northeast approximately 100 miles.

Rental Arrangements

Individual allotment holders of project water can readily transfer water for a season to anyone who wishes it by sending a water-transfer order to the conservancy district office. This office then turns the water to the renter's ditch on the day desired.

Municipalities and irrigation companies also rent water to water users from their allotments of project water.

Water rental practices vary by irrigation companies according to the size and historical development of the company. Rental procedures for representative companies in the South Platte Basin are presented in table 1. The smaller companies keep no record of transfers. Any exchange of water is an arrangement between individuals. The ditch rider is informed of changes to be made in water deliveries.

The large irrigation companies with from 100 to 300 stockholders maintain a rental service in the company office. Typically, water users who have excess water list it with the secretary, and those who need additional water contact the secretary to obtain it. In some companies, the rental price of water is set by the board of directors. Everyone who buys or sells water does so at the established price.

Other companies list the water available, together with the asking price. Users who need additional water take the lowest priced water, or haggle with the owner for a still lower price. If the season turns hot and dry, the price rises and more shares of water are likely to appear on the market. As the rental price rises, farmers who have low-return uses for water, such as pasture or hay land, will obtain a higher return by renting water to farmers who need water for such high-value crops as corn or sugar beets.

Most companies have water available for rent from different sources. One type is irrigation-company stock for a season—this is direct-flow and some reservoir water, depending on the company. The exact quantity of water delivered depends upon the flow of the river and must be used when available, or it is lost.

Another type of rental water is reservoir-company stock delivering a specified quantity of water from a privately owned reservoir. This water can be rented by day's run, which is normally 2 or 3 acre-feet, or by the share, which can vary in quantity from 10 to 100 acre-feet and is delivered on a demand basis. In certain instances, reservoir water can be transferred between adjacent companies.

Farmers can also rent project water to be delivered to their farms, independent of the parent company's water supply. Transfer of project water was described earlier. Water is commonly priced the same regardless of source.

TABLE 1.—*Representative water-rental procedures in the South Platte Basin*

Company	Method of renting	Method of pricing	Kind of water rented
Larimer and Weld Ditches, Eaton, Colo.	Available water is listed in company office. Secretary allocates to those wanting additional water.	Board of Directors sets price for season.	Reservoir water rented by day's run.
New Cache La Poudre Irrigating Co., Greeley, Colo.	Available water is listed in company office. Buyers contact secretary for water.	Secretary and Board of Directors set price for season.	Reservoir water rented by day's run. Few shares of direct-flow water rented each season.
Water Supply and Storage Co., Ft. Collins, Colo.	Shares of seasonal water are rented from the office. Small daily transfers are traded between farmers. No office record is kept.	Farmers set the price of both seasonal and daily rentals.	Both direct-decree water and reservoir water are rented by the day and the share.
North Poudre Irrigation Co., Ft. Collins, Colo.	Water for rent is listed on a board in office. Farmers who need water contact one of those listing water.	Asking price quoted along with number of shares each individual has for rent.	Shares of stock including both direct-decree and reservoir water are rented.
Greeley and Loveland Irrigation Co., Greeley, Colo.	Lists water only if requested. Most rentals are between farmers	Farmers set the price.	Mostly Colorado-Big Thompson water is transferred.
Bijou Irrigation District and Riverside Irrigation Co., Ft. Morgan, Colo.	Farmers arrange for transfers. Transfer orders are recorded in office.	Farmers negotiate price when arranging transfer.	Mostly reservoir water by the share, but some direct-decree water when farmer has well.
Farmers Reservoir and Irrigation Co., Denver, Colo.	Most water rented between farmers. Must submit water transfer order to company office to effect transfer.	Farmers set price.	Rent stock or acre-feet. Most rentals are reservoir water.

Size of the Water Rental Market

The Northern Colorado Water Conservancy District and five major companies in the area have made their water-rental records available for study. These records indicate that rental water is an important feature in the irirgated agriculture of the South Platte Basin.

During the 1959 season, 645 transfers of irrigation water took place in these companies, thus shifting the use of 16,353 acre-feet of water. In the conservancy district, 376 transfers totaling 73,967 acre-feet of water were completed. Although water is rented from March to October, the greatest activity occurs in July, August, and September (table 2).

Most rental transfers involve relatively small quantities of water. As shown in table 3, 88 percent of the transfers in 5 irrigation companies were below 50 acre-feet of water per transaction, and almost 75 percent below 30 acre-feet. The conservancy district records (table 4) show that about 80 percent of the transfers were below 80 acre-feet in quantity and that 72 percent were below 60 acre-feet.

About 70 percent of the water volume transferred within mutual companies was in units of less than 60 acre-feet, while rentals of less than 60 acre-feet accounted for only about 9 percent of the water shifted in the conservancy district.

Rentals of more than 2,000 acre-feet per transaction account for 65.8 percent of the water transferred in the conservancy district, but only 3.2 percent of the transactions. These large transfers involve water allotted to municipalities by the conservancy district but which the cities do not now need. The cities rent large blocks of water to irrigation companies to supplement their water supplies. Cities can transfer the water to their own uses as need arises. This flexible arrangement allows for ease of transfer whenever domestic or manufacturing users require additional water.

TABLE 2.—*Water rentals by months for five irrigation companies and the Northern Colorado Water Conservancy District, 1959*

Month	5 irrigation companies			N.C.W.C.D.		
	Transactions		Amount of water	Transactions		Amount of water
	No.	*Pct.*	*Acre-feet*	*No.*	*Pct.*	*Acre-feet*
March	3	0. 5	69	2	0. 5	228
April	8	1. 2	476	11	2. 9	3, 659
May	20	3. 1	1, 064	14	3. 7	9, 180
June	45	7. 0	1, 877	22	5. 8	11, 975
July	149	23. 0	4, 115	105	28. 0	14, 777
August	220	34. 1	4, 391	131	34. 9	22, 745
September	196	30. 4	4, 332	88	23. 4	9, 166
October	4	. 7	29	3	. 8	2, 237
Total	645	100. 0	16, 353	376	100. 0	73, 967

Rental Rates and Value of Water

Under the assumptions of marginal theory, the allocation of resources in a competitive industry will be such that the value of marginal product of any factor is equal between firms. When water is distributed under the appropriation doctrine, the returns to water can vary considerably between firms. Rental provisions help to adjust this malallocation of water. In the process of reallocation, the price of rental water should reflect the value of the marginal product of water to both the renter and the rentee.

In 1959, much of the water was rented at a price that covered the yearly stock assessment plus interest on the market value of the stock. Two companies set the price of water for the season at $2.70 and $3.25 per acre-foot. For the companies that let the farmers set the price, the charge ranged from $2.50 to $5 per acre-foot at the beginning of the season and from $4.20 to $8 late in the season (table 5).

In dry years, when the supply of water is short, the price is reported to go as high as $30 per acre-foot. Most irrigation officials and farmers think this is too high. Community pressure does not allow the market price to reach the level that farmers short of water would be willing to pay. Institutional restraints are one of the peculiarities of the water-rental market. The customary price of rental water probably limits the quantity of water that is available in some years.

The economic value of this rental water is not known because use of the water transferred was not ascertained, but it is possible to estimate its value from the returns to irrigation water in this region. A recent linear programming study made at Colorado State University[1] showed marginal values of irrigation water varying from $50 per acre-foot with a short water supply to $15 per acre-foot with a full supply. These values were ascertained for typical irrigated crop systems. A second stage of this study found the value of marginal product with adequate water supplies ranging from $32 per acre-foot on farms with soils of high productivity and high-value crops, down to $9 per acre-foot on farms with poor soils and low-value crops.

Another study[2] on the average gross return from an adequate water supply on various crops gave gross values of $72 per acre-foot when applied to sugar beets, but only $10 when applied to oats.

[1] Whittlesey, Norman. Economics of Irrigation, Uncompaghre Project, Unpublished MS. Thesis, 1959.

[2] Unpublished data from the Northern Colorado Water Conservancy District.

TABLE 3.—*Number and amount of water-rental transfers in five irrigation companies,[1] South Platte Basin, 1959*

Size of transfer (acre-feet)	Transfers	Cumulative percentage	Amount of water	Cumulative percentage
	Number	*Percent*	*Acre-feet*	*Percent*
0 to 9.9	175	27. 1	977	6. 0
10 to 19.9	180	55. 0	2, 430	20. 9
20 to 29.9	126	74. 5	3, 084	39. 6
30 to 39.9	56	83. 2	1, 872	51. 2
40 to 49.9	33	88. 3	1, 426	59. 9
50 to 59.9	29	92. 8	1, 604	69. 7
60 to 69.9	9	94. 2	564	73. 1
70 to 79.9	10	95. 8	759	77. 7
80 to 89.9	5	96. 6	420	80. 3
90 to 99.9	1	96. 8	96	80. 9
100 to 149.9	14	99. 0	1, 774	91. 6
150 to 199.9	4	99. 6	681	95. 9
200 plus	3	100. 0	666	100. 0
Total	645		16, 353	

[1] North Poudre Irrigation Company, New Cache La Poudre Irrigation Company, Larimer and Weld Ditch Companies, Farmers Reservoir Company, and Bijou Irrigation Company.

TABLE 4.—*Number and amount of water-rental transfers in the Northern Colorado Water Conservancy District, 1959*

Size of transfer (acre-feet)	Transfers	Cumulative percentage	Amount of water	Cumulative percentage
	Number	*Percent*	*Acre-feet*	*Percent*
0 to 19.9	102	27. 1	1, 082	1. 5
20 to 39.9	101	54. 0	2, 726	5. 2
40 to 59.9	67	71. 8	3, 130	9. 4
60 to 79.9	30	79. 8	1, 953	12. 0
80 to 99.9	8	81. 9	658	12. 9
100 to 149.9	27	89. 1	2, 888	16. 8
150 to 199.9	3	89. 9	503	17. 5
200 to 499.9	17	94. 4	4, 913	24. 1
500 to 999.9	7	96. 3	4, 882	30. 7
1,000 to 1,999.9	2	96. 8	2, 602	34. 2
2,000 to 2,999.9	3	97. 6	6, 141	42. 5
3,000 to 4,999.9	6	99. 2	18, 780	67. 9
5,000 plus	3	100. 0	23, 709	100. 0
Total	376		73, 967	

TABLE 5.—*Variable cost and rental price of water per acre-foot, representative irrigation companies, 1959*

Company	Cash cost per acre-foot[1]	Rental price per acre-foot	
		Early season	Late season
	Dollars	*Dollars*	*Dollars*
North Poudre Irrigation Co	2. 50	2. 50	4. 20
New Cache La Poudre Irrigation Co	2. 50	3. 25 all season	
Greeley and Loveland Irrigation Co	2. 87	3. 00	5. 00
Water Supply and Storage Co	1. 92	5. 00	8. 00
Farmers Reservoir and Irrigation Co	4. 04	4. 60	6. 00
Larimer and Weld Irrigation Co. and Windsor Reservoir Co	1. 03 3. 72	2. 70 all season	

[1] The cash assessment divided by water delivered per share.

Conclusions

It can be assumed that the water transferred moves to a higher value use. If, for example, the water transferred returned $20 per acre-foot more at the new location and 60 percent of the water actually reached the farm, water rentals in the conservancy district and the five companies would add around $1,000,000 to the gross return of the area. More water is actually rented in this area, but data cannot be obtained from some companies. These estimates indicate, however, that substantial returns are gained from seasonal transfers of water.

By using a market mechanism to allocate water within a framework of the appropriation doctrine, considerable losses in crop production have been avoided. The rental system also reduces the waste that occurs when water rights become involved in costly, time-consuming legal battles. One water user cannot bring suit against another for nonuse and transfer of irrigation water. Under the rental procedures used in the South Platte Basin, water can be transferred within irrigation companies by rental of stock and between or within irrigation systems by transfers of Northern Colorado Water Conservancy District water allotments.

These rules and customs, which developed during the last 60 years for company rentals and the last 10 years for Conservancy District transfers, make possible a better adjustment of the land-water relationship than is normally found in western irrigated agriculture. They might well serve as examples for other areas in adjusting for the varying needs of water users.

Book Reviews

Readings in the History of American Agriculture. Edited by Wayne D. Rasmussen. University of Illinois Press, Urbana. 1960. 340 pages. $6.50.

TO PRODUCE a first rate job of editing a series of documents requires as much time and imagination as any other type of scholarly production. Since the best documents are often found in unusual places, an editor must search broadly in order to acquire the most significant items. Once obtained, they pose the question of how much editing they require. If too little, they may puzzle rather than instruct the reader. If too much, the heightened sense of reality that such documents can convey is lessened. Occasionally an editor handles all these problems remarkably well and his book enjoys a long period of usefulness in the field for which it is intended. Rasmussen's volume should achieve such a position.

The theme of these readings is stated in the preface. The purpose of the volume is to bring together a documentary story of how the American farmer, with the help of various agencies, freed America from the fear of famine, and released America's energies from the necessity of spending most of its efforts in feeding itself. Although this constitutes the history of American agriculture, the sharpened theme points up the story.

The documents come from a wide variety of sources, including early books on agriculture, publications of agricultural societies, farm journals, advertisements in newspapers, mechanics magazines, religious periodicals, legislative documents, reports of local, State and Federal bureaus and departments, and manuscript collections.

Most of the 52 selections highlight important landmarks in our agricultural history. In many cases they constitute the first public announcement of specific events that led to significant changes in American agriculture. In virtually every case they effectively illustrate the point that the editor wishes to make. Readers of the volume will find many of the documents are new to them.

Rasmussen has arranged his material under eight major headings. Each is introduced with a short explanatory statement fitting it into the history of the movement or the idea that it illustrates. These notes orient the reader who already has some familiarity with the subject, and they serve as leads for further study on the part of those unacquainted with the field.

In introducing a document concerning a petition from the Illinois legislature to Congress on behalf of land grants for agricultural colleges, Rasmussen presents an excellent summary of names and forces behind this idea from the early 1800's. In the field of genetics, the editor of these readings introduces a statement by Wilbur O. Atwater in 1869 with information on predecessors, such as Sylvester Graham, and indicates also the direction taken by research in the decades following Atwater's work. In such comments, the editor displays his wide acquaintance with the literature of agricultural history and his ability to select those facts best suited to introduce the reader to the document at hand.

Adverse criticisms are likely to be minor in nature. Some will dislike separating the illustrations from the factual material to which they relate. The description of McCormick's 1834 reaper and the accompanying drawing, for instance, appear at widely separated places in the book. The editor could have eased the problem of reading documents in some cases by explanatory material covering obsolete or technical words. No scheme of classification will satisfy everyone, no matter how logical or rewarding it may be.

As a whole,however, the book will be acclaimed as a useful and provocative addition to the field of agricultural history. It will make an excellent textbook for advanced courses in agricultural history. Students of agricultural history everywhere will find the material surprisingly fresh and provocative. Rasmussen has achieved a high level of performance in selecting, editing, arranging, and interpreting his material.

Lewis Atherton

Fifty Years of Citrus—The Florida Citrus Exchange, 1909–59. By James T. Hopkins. University of Florida Press, Gainesville. 279 pages. 1960. $5.00.

THE 20-FOLD EXPANSION in production of citrus fruit in Florida during the last half century, to make it the leading citrus State, has been accompanied by parallel growth in marketing of the fruit. Among organizations engaged in the marketing of Florida citrus over this span of years was the Florida Citrus Exchange, a federated marketing cooperative, a history of which is presented in the book here under review.

Interwoven in the history of this marketing organization are many elements of the Florida citrus industry as a whole, such as the development of grades and standards for citrus, processing, transportation, and market outlets, both domestic and foreign. Hence, this book to some extent traces the growth of the entire citrus economy of this State.

This book is also a history of leaders in the development of the Florida citrus economy. It records the views and actions of the men who initially saw the benefits of a strong central marketing organization as a factor in the growth and operation of the citrus economy and who had the fortitude to make their visions a reality.

It also records the views and actions of the people who carried their organization, and with it much of the citrus economy, through good years and bad years to new heights of attainment. Many of the people mentioned over the past decade may be recognized among the leaders of today.

This history of the Florida Citrus Exchange comprises 38 chapters. The first is an introduction dealing with ideas and events leading to the creation of the Exchange and the other 37 cover one or more years at a time of the 50-year period. Each chapter reviews important events of the period covered and includes a listing of officers, directors and others associated with the Exchange. Readers may find these listings monotonous to cover and may skim or skip them, except perhaps those in the first few and concluding chapters. Otherwise, the book is easy to read. It is well written. It is a valuable addition to our literature on citrus.

The greatest appeal and usefulness of this book should be, of course, for those currently associated with the Florida Citrus Exchange. It also should be of much value to others concerned primarily with citrus fruit or interested in cooperative marketing. Students interested in case studies of marketing organizations should find it useful.

Ben H. Pubols

God Speed the Plow; The Coming of Steam Cultivation to Great Britain. By Clark C. Spence. University of Illinois Press, Urbana. 1960. 183 pages. $4.75

THE PRESENT-DAY farm tractor, powered by an internal combustion engine, is the answer to the need for mechanical power on British and American farms today. It has not always been so, and it may not be so in the future. While animal power was by far the most important immediate predecessor to the modern tractor, steam power was used in both Great Britain and the United States. This volume recounts the history of steam power on British farms.

British inventors and farmers made many experiments with steam power between 1820 and 1850. Greatest emphasis was on plowing, though steam engines were used for other farm operations. During the 1850's, many previous ideas were consolidated into practical form. By the mid-1860's, steam cultivation had become an accepted part of British large-scale farming. The high point in its development was reached in the 1890's, just as its great competitor, the internal combustion engine, was coming into the picture. It was not until World War I, however, that farm tractors with internal combustion engines displaced steam engines on British farms.

Steam never became a dominant feature of English husbandry, nor did its use bring inevitable economic advantage.

The use of steam was widespread but not general. It was confined almost entirely to large holdings. As Professor Spence points out, more than a few attempts to introduce steam power failed. The cost of the engine and related apparatus was high, and repair costs seemed to many users to be excessive. Small holdings did not justify the high initial investment necessary. Poor farm management often made success unlikely. Most of the

companies established to do custom plowing with steam apparatus failed, for various complex and interesting reasons.

The author, who is assistant professor of history at Pennsylvania State University, has given us the definitive history of steam plowing in Great Britain. The book, which won the 1959 Agricultural History Society Award, will be of interest to economists, historians, and technologists. It represents a major contribution to the field of agricultural history.

Wayne D. Rasmussen

The Competitive Potential of the U.S. Cotton Industry. By Clifton B. Cox and Vernon W. Pherson. Harvard University Graduate School of Business Administration, Division of Research, Boston. 201 pages. 1959. $3.00.

OVER THE YEARS, the cry, "King Cotton is dying" has been heard often, and the considerable concern over the King Cotton's "death" is reflected in a growing list of publications that offer prescriptions for survival. This book, published under the auspices of the Program in Agriculture and Business at the Harvard Business School, attempts to assess the competitive potential of cotton and the U.S. cotton industry in both domestic and foreign markets.

Professors Cox and Pherson try to cover all facets of the "cotton problem," though they contribute little in the way of methodology and new analysis. But they do accomplish a monumental task in combining, through abstracting and summarizing, many of the studies related to the market potential of cotton completed by the U.S. Department of Agriculture, the National Cotton Council, and others. They believe cotton's future is tied to per capita real income, and to price, quality, promotion, and trade arrangements.

After analyzing the separate effect of each factor on the competitive potential of cotton, the authors conclude that no single factor would insure future market expansions for cotton. All except real income were felt to be controllable by interested groups.

Real income is considered important to the cotton industry, but it is assumed that the demand for all textile fibers, including cotton, will increase at about the same rate. Thus, the authors argue that the future of cotton depends on how well it competes with other fibers for markets—or on interfiber competition. They believe that cotton can best compete with other fibers through competitive pricing, quality improvement, sound promotion, and a healthy trade environment. They conclude that, given these favorable conditions, cotton could expect an increased market averaging about 750,000 bales per year for the next decade. Given less favorable conditions, losses of markets could average 500,000 bales per year.

In their analysis, the authors have identified important factors that will determine cotton's share of the total textile market. But their assumption that future textile markets will increase at about the same rate as real consumer income is open to serious question. In the period since the end of World War II, consumer demand for total textile fibers has failed to keep pace with increases in consumer real income as other consumer goods and services have successfully competed for a larger share of consumer expenditures. In light of this, relative to the authors' assumptions of the effect of income on consumption, the estimated increase in cotton's markets (domestic and foreign) seems somewhat optimistic.

The authors have not provided a model for forecasting the demand for cotton, in either domestic or foreign markets. In their attempt to quantify future gains and losses in cotton's markets, no attempt is made to isolate the contribution of each factor to gains or losses in markets. The analysis would have been greatly strengthened by the derivation of coefficients of the variables which would provide a basis for forecasting, though admittedly it would be difficult to quantify the contribution of factors such as quality and trade arrangements to cotton's future.

The primary contribution of this work is, perhaps, its bringing into clear perspective the complexities involved in evaluating the competitive potential of the cotton industry. In particular, the authors point out the seemingly irresolvable conflicts along political, economic, and sociological lines that arise when alternative courses of action are considered for the cotton industry.

James R. Donald

The Price Discrimination Law. A Review of Experience. By Corwin D. Edwards. The Brookings Institution, Washington, D.C. 698 pages. 1959. $10.00.

THE SHERMAN ACT of 1890 forbade restrictive agreements and monopolization without mentioning discriminatory practices. Experiences under this act indicated the need for restrictions on price discrimination. The Clayton Act of 1914 against price discrimination was intended to prevent monopoly in its incipiency by striking at practices by which powerful enterprises might attain or consolidate control of their markets. Difficulties in effective application of the Clayton Act led to the passage of the Robinson-Patman Act of 1936, which was designed to cope more effectively with price discrimination that had significant effects on business opportunities, whether these effects changed the vigor of market competition or increased the probability of monopoly.

Dr. Edwards confines his book mainly to a study of the problems of discrimination that have arisen and remedies that have been applied under the Robinson-Patman Act. Problems and proceedings under other statutes are discussed only to the extent necessary to an understanding of cases under the Robinson-Patman Act to which they have some relationship.

In early sections of the book concepts of the law in some detail are set forth, together with the general characteristics of its administration. A chapter on legislative history attempts to determine what Congress was trying to do, and a chapter on content of the statute presents an analysis of the legislation that emerged. Following these is another on administration, which shows a classification of the cases involved and sets forth the peculiarities that were introduced by the administrative processes of the Federal Trade Commission.

The main body of the book is devoted principally to an analysis of the operative meaning that the legal concepts have acquired in cases decided by the Federal Trade Commission and in a few of the major private cases. In addition, there is an analysis of the enforcement activities under the act, based on the record and on interviews with a number of companies that were affected.

The substantive portion of the book is followed by two chapters devoted to an appraisal of the American price discrimination policy. One attempts to evaluate the Robinson-Patman Act itself, and the other sets forth tentative suggestions for a modification of the statute and of the policy that underlies it.

The book appears to be well organized and well written. It is an important contribution to the literature on the problems of price discrimination.

L. D. Howell

Taxes for the Schools. By Roger A. Freeman. Institute for Social Science Research, Washington, D.C. 441 pages. 1960. $5.00.

IN 1955, the Commission on Intergovernmental Relations (the Kestnbaum Commission) made the following statement concerning education:

> "The question is not whether the United States can afford to spend more on education than it does now, but how the needed funds can be raised."

This is the problem that occupies Mr. Freeman's attention in his thorough analysis of the present crisis in school financing.

His central theme, however, is not the raising of revenue per se, but whether the Federal Government rather than the various State-local governments shall assume the additional burden. To quote Mr. Freeman, the real issue is "who will hang the bell around the cat's neck."

Traditionally, State and local governments have been responsible for the control and support of their educational systems. Currently, because of fiscal difficulties which the author believes to be more apparent than real, serious consideration is given to legislation that would shift some of the financial responsibility from the local level to the Federal Government. According to the author, the vehicle used to further this aim—a Federal grant-in-aid for this specific purpose—would slowly erode State and local control over the educational system. Thus, the question is one of centralization vs. local control of this function.

A survey of several recent studies leads Mr. Freeman to the conclusion that "school revenue needs will double between 1958 and 1970, climbing

from $12 to $24 billion." Of the $12 billion needed, $6 billion will be raised under the existing tax structure as a result of projected growth of the economy. The remainder can be raised only through curtailing other governmental activities—which the author believes to be highly unlikely—or through an increase in taxes.

The author presents a definite program for raising the additional $6 billion. If his recommendations are followed, $2.5 billion will be collected from wider use of the sales tax with slightly increased rates; $2.5 billion from property taxes; and $1 billion from miscellaneous sources (including State income taxes). The alternative would be increased Federal grants-in-aid, which would be derived largely from the Federal income tax.

The financial implications of these alternatives should be of considerable interest to farmers. Taxes on farm property have doubled since 1947–49, largely as a result of rising school costs. In rural areas, close to two-thirds of all local government expenditure goes for schools.

A thorough analysis of the entire tax structure is presented to support the author's program. In contrast to many observers, Mr. Freeman holds that it is the income tax, rather than the local levies, that has been strained to capacity—and perhaps even beyond this elusive point. To this reviewer, his arguments are not convincing. But the statement that "federal revenues fell short of meeting expenditures, 4 years out of every 5 in the past 3 decades" does not take into account the deliberate deficit financing on the part of the Government. Nor does the inclusion of the 1930's in this statement appear justified. In that era, the income tax was largely a "rich man's tax," and no attempt was made to utilize it to the extent done now. The point Mr. Freeman makes about income tax receipts increasing only 62 percent between 1944 and 1959, while all other taxes increased 207 percent, is even less convincing. Percentage changes can be highly misleading, and different results can be obtained by choosing a different base year.

The amount of revenue a closing of "loopholes" would bring is open to question. The statement that ". . . considering the extremely high tax rates, income tax compliance is amazingly good" suggests that the general public is not "revolting" against this levy. Finally, the author's implication that incentives are affected by the high tax rates does not take account of a series of studies conducted at Harvard which concluded that the tax structure did not harm incentives.

But Mr. Freeman's case does not fail because of the inclusiveness of his charges regarding the income tax. His point about the sales tax being the "underdeveloped area of taxation in the United States" is well made. Only 35 States collect a retail sales or gross receipts tax with the "average rate" at 3 percent. The major objections to the sales tax arise from differing concepts of social justice. Mr. Freeman's reply to the charge that sales taxes are regressive is that the mild regressivity of the sales tax is more than offset by the sharp progressivity of the Federal income tax. He then quotes several studies which imply that the sales tax is roughly proportionate throughout most of the income range and is only regressive at the extreme ends of the scale. He predicts that "if the States expand in the retail sales tax field as much in the 1960's as they did during the 1950's, they may collect an additional $2.5 billion (beyond the normal growth) which can be allocated to the schools."

Mr. Freeman attempts to refute the major criticisms of the traditional mainstay of local government, the property tax, and correctly points out that what is needed is several major reforms in the administration of this measure rather than its abolition.

Mr. Freeman concludes that financial responsibility for education is best left at the local level. The alternative of shifting some of this responsibility to the Federal Government "would fundamentally change the historical relationship between the American local community and its public schools." He doubts "that it would be a change for the better."

Harvey Shapiro

Operations Research and Systems Engineering. Edited by Charles D. Flagle, William H. Huggins, and Robert H. Roy. Johns Hopkins Press, Baltimore. 889 pages. 1960. $14.50.

THE BASIC CONCEPT involved in operations research and systems engineering is the analysis of complex man and machine systems using a group of specialists from diverse fields. The similarities between operations research and systems engineering are more important than their differences. The concepts and techniques employed in problem analysis are much the same; the difference is that operations research is concerned with making procedural changes while systems engineering is concerned with equipment changes.

The fields operations research and systems engineering are of comparatively recent origin. They were first used extensively during World War II when they were applied to such problems as antisubmarine warfare and the sea mining of Japan.

In economic terms, operations research could be said to be concerned primarily with the allocation of resources. The techniques employed should be useful, or at least of interest, to anyone engaged in production and marketing. Although operations researchers claim to apply the entire scope of human knowledge to the solution of whole problems, they rely rather heavily on the application of mathematics and statistics. And the "seven classical operations research models—allocation, queueing, inventory, sequencing, routing, replacement and competition—" all deal with problems faced in production or marketing.

An example of the application of operations research to an agricultural problem is the Seabrook Farms Experiment, mentioned briefly in this work. The problem was to stagger the planting dates for fields of peas so that a freezing plant could operate with maximum efficiency, that is, the plant would operate at capacity for the longest possible period of time with no loss from overripe or immature peas.

This is the third large volume of collected papers arising from the John Hopkins University annual 2-week course on operations research for management. The editors have done a creditable job of organization, but with 20 authors from various departments, this type of compilation leads inevitably to an unevenness of style and an occasional discontinuity of thought between chapters.

The book is divided into three parts: (1) Perspectives, (2) Methodologies, and (3) Case Studies. In the background material given in the first section, the editors treat operations research and systems engineering as two separate fields, but their similarities cause considerable repetition in some of the chapters. In a broad survey of these fields, such as this book purports to be, it would probably be better to stress basic similarities rather than minor differences. And in a book of this size, all reductions in redundancy would be appreciated by the general reader.

More than half of the volume is devoted to the explanation of the methodologies employed in operations research, and this is the real meat of the book. The other sections are the trimmings; these appear to be more or less haphazardly appended. Most of the chapters on methodology give excellent insight into the mathematical processes involved, and provide simple examples of the solution of problems in such subjects as statistical quality control, game theory, and inventory systems.

The third section presents four case studies of the application of operations research to specific problems. The simulation of tactical war games shows some of the possibilities of the application of diverse disciplines to the solution of a problem. But some of the other illustrative cases, such as the study on the cost of reports to a telephone company, appear to be basically problems in cost accounting.

Some insight into the fields of operations research and systems engineering is gained from parts one and three. The wide range of subjects covered in the second section—from basic statistics to information theory—makes interesting reading for anyone who may desire an introduction to the methodology but who does not have the background necessary for following complex expositions of mathematical theory.

Arthur A. Harlow

Agricultural Economics Research in Asia and the Far East. The ECAFE/FAO Agriculture Division of the Economic Commission for Asia and the Far East. United Nations and Food and Agriculture Organization of the United Nations, Bangkok, 1958. Columbia University Press, New York. 100 pages. 1960. 75 cents.

THIS STUDY examines the role of government agricultural economic organizations and brings together available information on current research work in Asia and the Far East.

Annual Review of World Production, Consumption, and Trade of Fertilizers—1959. Food and Agriculture Organization of the United Nations. Columbia University Press, New York. 140 pages. 1960. $1.50.

THE PURPOSE of the review is to record and analyze the production, consumption, and trade of fertilizers in the world and in the different continents and countries. It is based on data received from governments up to November 1959.

Statistical Yearbook 1959. Statistical Office of the United Nations. Department of Economic and Social Affairs. Columbia University Press, New York. 618 pages. 1960.

THIS ELEVENTH ISSUE of the *Yearbook* contains data from more than 150 countries and territories that submitted statistics by completing questionnaires, and from others that made their national statistics available by means of published documents.

The State of Food and Agriculture, 1960. Food and Agriculture Organization of the United Nations. Columbia University Press, New York. 182 pages. 1960. $2.00.

THIS ANNUAL reviews the world situation and outlook for agricultural production, changes in stocks, economic activity and demand for agricultural products, food supplies and consumption, international trade in agricultural products, farm prices and incomes, consumer prices and sales, agricultural policies and development plans, and commodity survey and outlook. It includes a section on programming for agricultural development and an annex which contains 17 tables.

Food Supply, Time Series. Food and Agriculture Organization of the United Nations. Columbia University Press, New York. About 80 loose-leaf unnumbered pages. 1960. $1.00.

THIS BOOKLET, printed on loose leaves that are removable from its covers, contains data on food consumption from the Food Balance Sheets. It is a supplement to FAO periodicals that contain the latest available food balance sheets.

Selected Recent Research Publications in Agricultural Economics Issued by the United States Department of Agriculture and Cooperatively by the State Colleges and Universities [1]

ANDERSON, J. R., AND DILL, H. W., JR. LAND CLEARING AND DRAINAGE IN EASTERN NORTH CAROLINA. U.S. Agr. Res. Serv. ARS 43–127, 47 pp., illus. January 1961.

Since World War II, farmers have cleared thousands of acres of land for agricultural uses in the middle Coastal Plain and tidewater counties of eastern North Carolina. Drainage activity is carried out by legally organized drainage districts, voluntary groups, and individual farmers. In Beaufort, Pitt, and Robeson Counties, where the four townships selected for detailed study are located, 43,000 acres have been cleared. In eastern North Carolina tile drains and open ditches are both used in draining farmland. Average cost of tiling was about $62 an acre compared with $25 to $30 for field drainage by open ditching. Where tile drains replaced open field ditches such advantages were observed as a saving of land and fertilizer and greater efficiency and convenience in operating tractor-drawn equipment.

BAUER, FREDERICK. HONEY MARKETING. Calif. Agr. Expt. Sta. Bul. 776, 71 pp., illus. (Agr. Mktg. Serv. cooperating.) December 1960.

This bulletin provides an analytical description of marketing organization and practices of the honey industry and offers suggestions for changed practices and further studies.

COWHIG, JAMES, ARTIS, JAY, BEEGLE, J. A., AND GOLDSMITH, HAROLD. ORIENTATIONS TOWARD OCCUPATION AND RESIDENCE. A STUDY OF HIGH SCHOOL SENIORS IN FOUR RURAL COUNTIES OF MICHIGAN. Mich. Agr. Expt. Sta. Spec. Bul. 428, 34 pp. 1960. (Agr. Mktg. Serv. cooperating.)

[1] State publications may be obtained from the issuing agencies of the respective States.

This bulletin presents results of research that was conducted to provide information on occupational and educational plans and aspirations of rural high school graduates; to discover reasons they give regarding their intentions to leave or stay in the community; and to determine the influence of professional people in the rural community on these decisions.

COWHIG, J. D., AND STEWART, E. O. THE OLDER FARM FAMILY AND MEDICAL COSTS. U.S. Dept. Agr. Inform. Bul. 235, 40 pp. December 1960.

Data from a 1956 national survey of farm-family living expenditures were analyzed to show the pattern and level of medical expenditures of older farm families—those in which the farm operator was 65 years of age or older. Five selected items of medical expense were analyzed to determine differences associated with factors such as family size, region, color, and economic and educational level. Medical expenditures in 1955 were compared with similar data from a 1935 survey and with 1950 medical expenditures of a sample of urban families.

CRECINK, J. C., AND HOOVER, H. INCOMES AND RESOURCES OF RURAL FAMILIES IN THE CLAY-HILLS AREA OF MISSISSIPPI. Miss. Agr. Expt. Sta. Bul. 604, 16 pp., illus. (Agr. Res. Serv. cooperating.)

Clay-Hills Area, comprising 18 counties in northeastern and east-central Mississippi, has for many years been characterized as a low-income area. One in three of the 59,000 open-country rural families received net money income of less than $1,000; and only 1 in 16 received more than $5,000. Underemployment, with the resulting low incomes, exists in the area mainly because of the low level of natural resources, relatively small operating units, and low level of investment. One-third or more of the farm and nonfarm families had incomes of less than $1,000.

CRUMLEY, B. B., AND COOPER, M. R. COTTON MERCHANDISING—COSTS, PRACTICES, AND PROBLEMS. Univ. Tex. and Tex. Technol. Col. (Agr. Mktg. Serv. cooperating.)

A healthy and progressive marchandising system, built upon a stronger program of research and education, can help make U.S. cotton more competitive in cost, quality, and sales efforts. One of the most important changes in merchandising cotton during the last two or three decades has been the increased use of instruments to measure or test the properties of cotton. In 1956–57 about 85 percent of the mill firms surveyed were using fiber tests in buying cotton. Relatively little change in differential pricing based on the measured properties has accompanied the increase in fiber testing.

DAVIS, E. G. THE ECONOMICS OF FARM MECHANIZATION IN THE UNITED STATES, 1950–1960. U.S. Dept. Agr. Libr. List 68, 16 pp. October 1960.

This selective bibliography is concerned with the costs of mechanization on the farm and the returns to the farmer either in reduction of labor costs or in the increased value of the crop.

FABER, F. L., PEDERSEN, J. R., AND GERALD, J. O. REPORTING EGG PRICES AT SHIPPING POINTS IN IOWA AND MINNESOTA. U.S. Dept. Agr. Mktg. Res. Rpt. 445, 47 pp., illus. January 1961.

This publication summarizes the results of research begun in 1957 to test the feasibility of developing a shipping-point price report and analyzes the reports issued during 1959. It supplements earlier research on egg pricing in New York City, Chicago, Los Angeles, and St. Louis.

FISHER, C. D., SIDWELL, A. P., AND GOLUMBIC, CALVIN. SORTING RAISINS BY THE AIRSTREAM METHOD. AN EVALUATION OF MECHANICAL SORTING OF NATURAL-CONDITION RAISINS FOR MATURITY AND TRASH CONTENT. U.S. Dept. Agr. Mktg. Res. Rpt. 451, 16 pp., illus. January 1961.

A device has been developed that removes immature raisins and trash from a sample of natural-condition raisins in 10 minutes, compared with an hour of hand work by the usual method. The device uses an airstream to blow out the lighter, immature raisins and trash. In repeated tests it satisfactorily separated immature fruits and trash from mature, acceptable raisins. Results were more accurate than the usual hand-sorting method.

HENDERSON, P. L., BROWN, S. E., AND HIND, J. F. SPECIAL PROMOTIONAL PROGRAMS FOR APPLES. THEIR EFFECTS ON SALES OF APPLES AND OTHER FRUITS. U.S. Dept. Agr. Mktg. Res. Rpt. 446, 31 pp. January 1961.

Sales of apples and oranges rose during special promotion for apples in retail food stores. An improved research method was used to study sales of fruit associated with special promotion of apples in 72 supermarkets in 6 midwestern cities. The promotion emphasized either the use of apples in salads, pies, and other dishes, or the healthful qualities of apples. Sales of apples were 32 percent higher during promotion using the apple-use theme, and 9 percent higher for the health theme, than for no promotion. Sales of oranges rose slightly when either theme for apples was used.

HESS, C. V. PROFITABLE ADJUSTMENTS FOR NEW YORK DAIRYMEN, MEDIUM-SIZED FARMS WITH HIGH-LIME SOILS, CENTRAL PLAIN REGION. N.Y. (Cornell) Agr. Expt. Sta. Bul. 952, 60 pp., illus. August 1960. (Agr. Res. Serv. cooperating.)

Presents an economic evaluation of alternative adjustments that dairymen might make on medium-sized dairy-cash-crop farms located on the Honeoye-Lima soils of the Central Plain Region in western New York. The current situation in the region was appraised with respect to the usual combinations of crops and livestock, current farm practices, income variability, and adjustment problems and resource situations that might influence farmers' ability to make appropriate changes in their farm organization and operations.

HESSER, L. F., AND JANSSEN, M. R. CAPITAL RATIONING AMONG FARMERS. Ind. (Purdue) Agr. Expt. Sta. Res. Bul. 703, 16 pp., illus. November 1960. (Agr. Res. Serv. cooperating.)

Farmers tend to use successively smaller proportions of the credit available to them as their net worths increase. More favorable attitudes towards credit, higher knowledge scores, and relatively less conservatism due to uncertainty were associated with smaller indexes of internal capital rationing.

HUGHES, W. F., AND MAGEE, A. C. SOME ECONOMIC EFFECTS OF ADJUSTING TO A CHANGING WATER SUPPLY, TEXAS HIGH PLAINS. Tex. Agr. Expt. Sta. Bul. 966, 27 pp., illus. October 1960. (Agr. Res. Serv. cooperating.)

The principal short-run physical effects of a decline in water levels are reflected by a reduction in well capacities. The long-run effect is a depleted water supply. The types of special practices or adjustments induced by or associated with the decline in water supplied include: (1) increasing hours of pump operation, (2) lowering pumps, (3) installing additional wells, (4) installing closed water-distribution systems, (5) installing smaller pumps in old wells, (6) decreasing acreage of summer-irrigated crops and increasing acreage of crops irrigated in fall and winter, (7) staggering grain-sorghum planting dates, (8) concentrating available water supply on cotton, (9) irrigating alternate rows, and (10) reducing number of acres of cropland irrigated per farm.

INMAN, B. T. AND SOUTHERN, J. H. OPPORTUNITIES FOR ECONOMIC DEVELOPMENT IN LOW-PRODUCTION FARM AREAS. A STUDY OF INCOMES, EMPLOYMENT, AND RESOURCES. U.S. Dept. Agr. Agr. Inform. Bul. 234, 38 pp., illus. November 1960.

In representative study areas—north-central and western Florida, north-central New Mexico, northern Lower Peninsula of Michigan, Clay Hills of Mississippi, Eastern Ozarks of Missouri, northeastern Tennessee, and northeastern Texas—about half the rural families had net annual incomes of less than $2,000 compared to a fifth of the rural families for the Nation as a whole. The proportion of the income of farm families that came from farming ranged from 20 percent in Texas to 50 percent in Mississippi. Chronic low incomes of families in the study areas result from (1) limitations in employment capabilities and capacities of the individuals; (2) lack of adequate farm resources to permit adoption of modern farming methods; and (3) impediments that hinder adjustments which would bring about fuller utilization of resources.

LARKIN, L. C. FARM AND RETAIL PRICES FOR BEET SUGAR. U.S. Dept. Agr. AMS–424, 4 pp., illus. November 1960.

The farmer's share of the retail value of beet sugar in 1959 was the same as in 1950 despite increases in farm price, retail price, and farm-retail price spread. Consumers paid about 11.4 cents a pound for beet sugar in large cities in 1959, an increase of 1.5 cents from 1950. Average farm price rose 0.5 cent, and farm-retail spread rose 1.0 cent. Because of the greater rise in wages of factory workers, a day's pay would buy 48 pounds more in 1959 than in 1950.

LERAY, N. L., WILBER, G. L., AND CROWE, G. B. PLANTATION ORGANIZATION AND THE RESIDENT LABOR FORCE, DELTA AREA, MISSISSIPPI. Miss. Agr. Expt. Sta. Bul. 606, 24 pp., illus. October 1960. (Agr. Res. Serv. cooperating.)

This is the second of a series dealing with farm labor and technology on large cotton plantations in the Delta Area. The sample for this phase of the study includes 172 Negro families living on 40 plantations having cotton allotments of 300 acres or more in 1957. The seasonal nature of cotton production is reflected in the average number of days worked and the earnings reported by plantation residents. If more productive use is to be made of manpower on large plantations, additional opportunities for farm or nonfarm employment are needed.

MCGRATH, E. J. THE MARKET FOR SOUR CREAM. U.S. Dept. Agr. Mktg. Res. Rept. 448, 36 pp., illus. January 1961.

Trend of sour cream sales is definitely upward. Sales of cultured sour cream in 1957, reported in a national mail survey, amounted to 73 million pounds. This quantity represented at least 90 percent of the U.S. total. Ninety-seven percent of the distributors and processors who returned the questionnaire said their volume was larger in 1957 than in 1956. Sales increased further in 1958 and 1959.

METZLER, W. H., AND SARGENT, F. O. MIGRATORY FARMWORKERS IN THE MIDCONTINENT STREAMS. U.S. Dept. Agr. Prod. Res. Rpt. 41, 62 pp., illus. December 1960.

A survey in six cities in southern Texas which have large settlements of migratory labor revealed that although migratory workers showed considerable skill in the timing and direction of their movement, practically all were underemployed. During 1956, they averaged only 131 days of work. Heads of households averaged 174 days. Problems of child support, regulation of child labor, and maintenance of educational opportunity are important aspects of the migratory movement. A comprehensive program to improve the timing of those who migrate is desirable to resolve these problems.

PINE, W. H., AND SCOFIELD, W. H. THE FARM REAL ESTATE MARKET IN KANSAS. Kans. Agr. Expt. Sta. Bul. 428, 20 pp., illus. January 1961. (Agr. Res. Serv. cooperating.)

Few of the tracts sold in four areas of Kansas in 1956 were large enough for economic farm units. About half had no buildings, and three-fourths had been farmed as parts of larger farms. Health, age, financial situation, and plans to buy other land were primary reasons for selling. Three-fourths of the buyers were active or retired farmers. Two-fifths of the buyers lived within 5 miles of the tracts they bought; they tended to pay higher prices than those living farther away.

PODANY, J. C. COSTS OF PACKING CALIFORNIA PEACHES IN 1959. U.S. Dept. Agr. Mktg. Res. Rpt. 443, 19 pp., illus. December 1960.

Total costs of packing California Red Haven and Early Elberta peaches in 1959 averaged slightly over 70 cents per 20-pound lug. Packing costs in individual sheds ranged from 64.7 cents to 80.8 cents a lug. Packing materials averaged nearly 60 percent of all costs, labor about 25 percent, and overhead about 15 percent.

REESE, ROBERT B., AND MILLER, E. B. GEOGRAPHIC DISTRIBUTION OF WESTERN FROZEN FRUITS AND VEGETABLES. U.S. Dept. Agr. Mktg. Res. Rpt. 441, 40 pp., illus.

About two-thirds of the commercial pack of frozen fruits and vegetables, excluding citrus products, originated in California, Oregon, Washington, and Idaho in 1954 and 1955. More than 60 percent of the western pack moved to points east of the Mississippi River. In individual trading centers, the market for western products shifted with changes in transportation cost and service relationships. Periodic appraisals of the share of the market held by western products would signal problem areas, focus attention on causes, and help in evaluating proposed solutions.

Risley, R. F. and Bright, Imogene. minimum wages in grocery stores. selected experiences in new york state U.S. Dept. Agr. Mktg. Res. Rpt. 439, 20 pp., illus. November 1960.

Average hourly labor costs rose less than 4 percent in stores that had been paying under $1 when New York State raised the minimum wage for retail grocery stores from 90 cents to $1 an hour. After the order became effective in January 1958, average weekly man-hours declined 14 percent in the stores affected by the order but also declined from 7 to 9 percent in the unaffected stores.

Taylor, M. M. rural people and their resources, north-central new mexico. N. Mex. Expt. Sta. Bul. 448, 28 pp., illus. October 1960. (Agr. Res. Serv. cooperating.)

Study was based on a sample of 171 rural nonfarm and 63 rural farm households. The study area has long been in a chronic and serious low-income position. Small subsistence farms are characteristic. In 1954, more than two-thirds of the farms were less than 30 acres in size but accounted for less than 1 percent of the total land in farms. Nearly 59 percent of the sample farm households and 55 percent of the nonfarm households had cash incomes of less than $2,000 in 1956. A high percentage of the incomes was from sources other than employment; nearly 20 percent of the sample households were receiving public assistance; 30 percent were receiving either unemployment compensation or public welfare, or both.

Thuroczy, N. M. impact of the st. lawrence seaway on the location of grain export facilities. U.S. Dept. Agr. Mktg. Res. Rpt. 442, 26 pp., illus. December 1960.

Direct overseas exports of U.S. grain from Great Lakes ports soared from 4 million bushels in 1958 to 90 million bushels in 1959, the St. Lawrence Seaway's first year of operation. Atlantic ports shipped 15 million bushels less in 1959 despite a gain of 140 million bushels in total grain exports. The Seaway had little or no effect on Gulf and Pacific ports. If exports continue below the level considered necessary for profitable operation of elevators at Atlantic ports, and if they cannot convert their operations to long-term storage, some of these elevators will close. Port facilities have been expanded at Gulf and Lake ports to handle increased volumes of grain.

Thuroczy, N. M. marketing margins for medium-grain rice. U.S. Dept. Agr. Mktg. Res. Rpt. 444, 23 pp., illus. December 1960.

While marketing margins on most foods were increasing sharply, wholesale margins for medium-grain rice declined 22 percent and retail margins 4 percent. Farmer's share of the wholesale price increased from an average of 78 percent for 1948–49 through 1950–51 to an average of 84 percent for 1956–57 through 1958–59, and his share of the retail price increased from 39 to 43 percent.

U. S. Agricultural Marketing Service. supplement for 1956–60 to farm-retail spreads for food products. U. S. Dept. Agr. Supp. for 1956–60 to Misc. Pub. 741, 40 pp. January 1961.

Brings up to date the statistics on farm food market basket presented in Part III of Farm-Retail Spreads for Food Products, Misc. Pub. 741, issued in November 1957.

Statistical Compilations

Durost, D. D. index numbers of agricultural production by regions, 1939–1958. U.S. Dept. Agr. Statis. Bul. 273, 37 pp., illus. December 1960.

Goodwin, J. W., Plaxico, J. S., and Lagrone, W. F. resource requirements, costs, and expected returns: alternative crop and livestock enterprises: clay soils of the rolling plains of southwestern oklahoma. Okla. Agr. Expt. Sta. Processed Ser. P–357, 54 pp., illus. September 1960. (Agr. Res. Serv. cooperating.)

Haldeman, Robert C., Bennett, Robert M., Corley, Joseph R., Foster, Ralph O., and Hunter, John H., Jr. grain transportation statistics for the north central region. U.S. Dept, Agr. Statis, Bul. 268, 131 pp., illus. Aug. 1960.

Hodges, E. F. animal units of livestock fed annually, 1909 to 1959. U.S. Dept. Agr. Statis. Bul. 271, 12 pp., illus. October 1960.

Hodges, E. F. livestock-production units, 1910–1958, and consumption of feed by livestock, 1955–1958. U.S. Dept. Agr. Statis. Bul. 275, 31 pp., illus. December 1960.

Mississippi Agricultural Experiment Station. statistical supplement, low income farm study, clay-hills area of mississippi. Miss. Agr. Expt. Sta. AEc. M. R. 30, 95 pp. January 1961. (Agr. Res. Serv. cooperating.)

Parsons, M. S., Robinson, F. H., and Strickler, P. E. farm machinery: use, depreciation, and replacement. U.S. Dept. Agr. Statis. Bul. 269, 37 pp. October 1960.

Texas Agricultural Experiment Station. production costs and expected returns; alternative crop and livestock enterprises; clay soils in the northern portion of the rolling plains of texas. Tex. Agr. Expt. Sta. MP–445, 54 pp., illus. September 1960. (Agr. Res. Serv. cooperating.)

U.S. GOVERNMENT PRINTING OFFICE: 1961

Reorganization of USDA Economics Services

A reorganization of the agricultural economics services in the U.S. Department of Agriculture was announced by Secretary Orville L. Freeman in February, to become effective April 3. The reorganization brings economic research and statistical reporting functions into two new agencies—Economics Research Service and Statistical Reporting Service. Economic functions and activities before the reorganization were scattered in Agricultural Marketing Service, Agricultural Research Service, and Foreign Agricultural Service. A Director of Agricultural Economics heads both new agencies. Dr. Willard W. Cochrane has been named Acting Director. The names of the administrators of the two new agencies had not been announced at the time this journal went to press in late March.

Activities of the new agencies involve an extensive organization of approximately 1,800 employees more than 800 of whom are outside Washington, D.C. Much of the work is done in cooperation with State departments of agriculture and land-grant colleges and universities.

Growth Through Agricultural Progress

AGRICULTURAL ECONOMICS RESEARCH

Is published quarterly by the Agricultural Marketing Service, U. S. Department of Agriculture. The printing of this publication has been approved by the Bureau of the Budget, Feb. 10, 1959.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. 20 cents a single copy, 75 cents a year, domestic, $1 foreign.